Engineering News-Record

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...y Pavements Be Used on State Roads?

THE accompanying picture shows one of Connecticut's newest state routes, 3-inch asphalt on 6-inch concrete base. It links two important industrial centers and carries an extremely heavy motor truck and bus traffic.

The economic reasons underlying the selection of such road types are discussed in a timely article in this issue:

"Hard Surface Pavements for State Highways"

By Charles J. Bennett
State Highway Commissioner of Connecticut.

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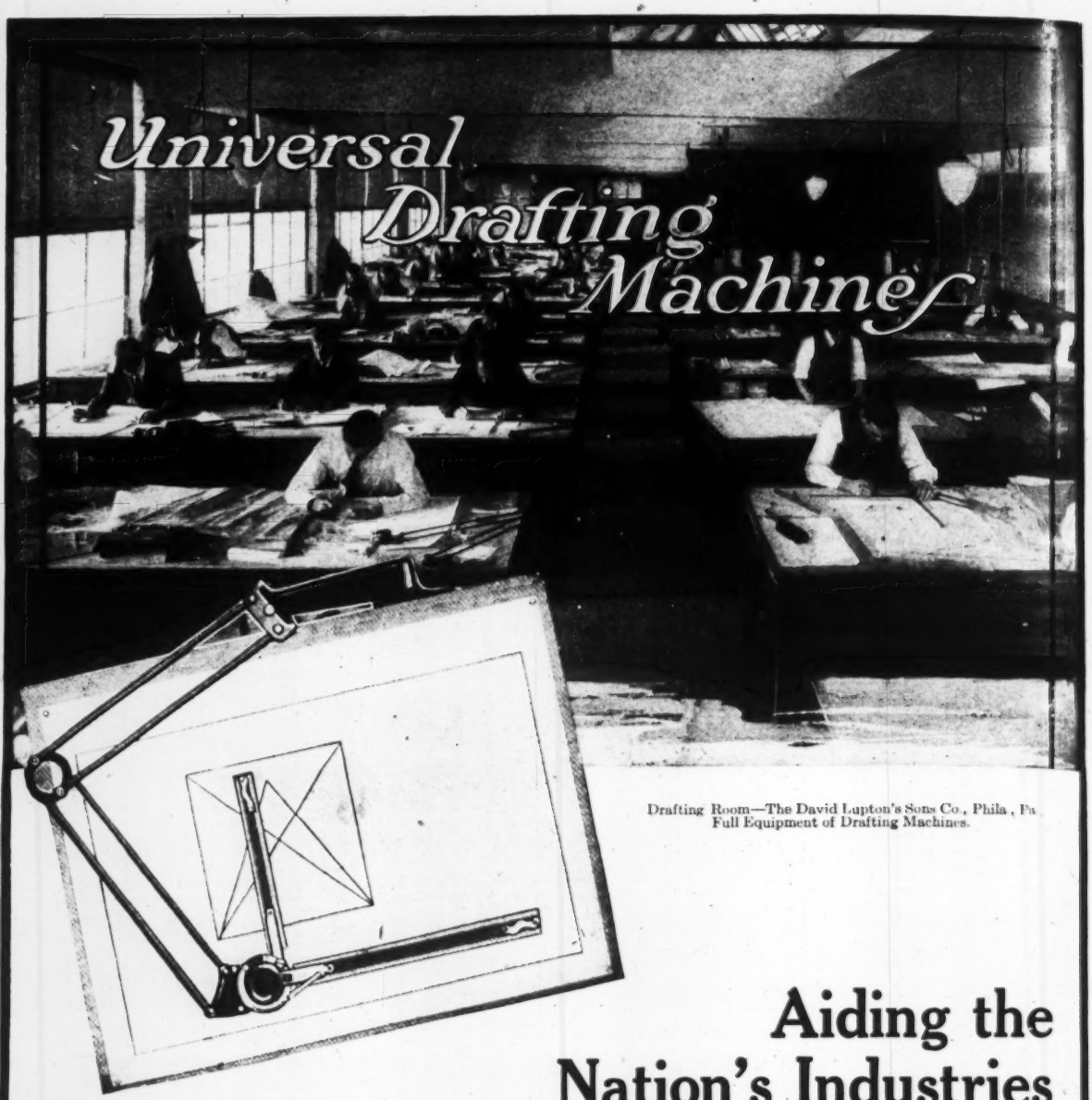

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And They Are Fighting in France

THE "Subsidence of Muck and Peat Soils in Southern Louisiana and Florida" was the title of a paper presented two weeks ago at the meeting of the American Society of Civil Engineers. With the exception of three war addresses, equally peaceful topics have occupied the meetings since last April. The fall program, so far as announced, contains no papers bearing on the tremendous industrial and engineering problems which the winning of the war demands that we solve. This is an engineering war, yet the society seems not to recognize its opportunity.

Sacrificing the Prejudices of One's Class

THREE sacrifices must be made by the peoples in this war, said H. W. Garrod, of the labor division of the British Ministry of Munitions, in an address in New York last week. The first is lives; the second, treasure, and the third, which he declared was the hardest to make, is the *sacrifice of the prejudices of one's class.* What a discussion could be hung on those seven words! What visions they bring up of past strikes and lockouts! How they mirror the industrial disputes of the day! How vividly and horribly they foreshadow the future—unless drastic action, drastic for capital and labor, be taken. To those who can think, who see beyond this day or this week, the words are a call to action, action which will speedily settle the situation as between employer and employed, which will force quickly those sacrifices of class prejudices to which Mr. Garrod's words refer. These are times for big men, for brave handling of pressing problems. Only one thing now matters, that we win the war; win it, of course, without doing injustice to anyone. Prejudices will go by the board eventually. Shall it be only after internal strife shall have prolonged the struggle and increased the toll of blood?

Intensifying Class Prejudice

AS AN example of obstinate adherence to the prejudices of one's class, we can conceive of nothing so extreme as the presidential address of William H. Barr before the National Founders' Association in New York last week. He sees the beam in labor's eye; he does not even entertain the thought that there may be a mote in the employer's. His address tells what labor must do; it does not suggest that capital also has responsibilities. He plays strongly on the prejudices of his class, and by so doing assures the militancy of the opponent. There is no note of coöperation. We hold no brief for present labor activities; we feel as strongly as Mr. Barr on most of what he condemns. But we do hold that in his address he failed of his opportunity to prepare the minds of his fellow foundrymen for the era of adjustment and concession and coöperation that certainly is coming. His position would have been all the stronger had he set forth first the employer's responsibility and then emphasized the failings of labor. Mr. Barr is patriotic. He wants us to win the war—he is helping in his plant to do it. But he does not see that a conciliatory spirit and a fair facing of the whole problem is necessary if we are to find a way out of the present industrial difficulties.

Straightforwardness as a Necessity of Today

KEENLY recognizing the differences between England and the United States, the members of the special mission representing the labor division of the British Ministry of Munitions have consciously refrained from giving advice during their visit in this country. But they show a deep appreciation of the difficulties that lie before us, and the uncolored recitation of their experiences [see page 957] should be a sufficient warning. The bare fact of their coming and remaining so long when their own troubles are by no means settled completely is, in itself, startling. Complex as the situation may seem at the present moment, they hold out the hope that it is so only superficially. The danger to guard against is not one of materials, but of man power. The error lies in the assumption of an attitude on the part of those in power which may suggest, either to employer or employed, that any motive besides the clearest and most immediate patriotism lies behind any action which circumstances may force.

An Attempt To Block the Shandaken Tunnel

THE award of the contract for the Shandaken tunnel of New York's Catskill aqueduct on Nov. 9 has drawn the fire of the incoming municipal administration, which will assume office Jan 1. In a letter to the Board of Water-Supply, Mayor-elect Hylan and two of his associates protest against proceeding at the present time with work which, according to the estimated quantities and bid prices, will cost more than $12,000,000. War conditions, resulting in high prices for labor and materials, are the reasons advanced by Judge Hylan

for holding up the work. [See last week's issue, page 945.] At present the city is using about 350,000,000 gal. of Catskill water daily, a clear indication that the output of the first installment of the work is not being held in reserve. Of course, as time goes on, the demand will become greater. It was for this very reason that the Schoharie watershed was, long ago, made an integral part of the Catskill project, yet criticism of the Shandaken contract has created, in some minds at least, the impression that it is "extra work," a plum which the outgoing administration was eager to pick before vacating office. As to the immediate need of the project its opponents forget that a tunnel 11 ft. 6 in. x 10 ft. 3 in., inside dimensions, and 18 miles long, can not be constructed in a few months. It is a matter of years. By the time the work is finished, there is good reason to believe, it will supply a real need. It is true that prices are high now. But who will say how much lower they are going to be next year or the year after? Then, too, there is available now the necessary experienced organization. The contractor who was low bidder on the Shandaken job and who secured the award is well qualified to undertake the work, for he has already demonstrated his ability by building the Wallkill pressure tunnel. There is no good reason why the work should not proceed. Certainly it should not be stopped for purely political reasons, and the Mayor of the city stated most emphatically before the national engineering societies last week that it would proceed.

Ocean Ports Must Be Developed

THE secondary ports of the Atlantic seaboard—and by that is meant all the ports but New York, for about 80% of the Atlantic foreign trade passes through that port—have never been able to compete with the metropolis, nor indeed have they even been able to realize a fair proportion of the business promised by modernization and enlargement of their facilities. Habits of shippers, the centralization of the big railroads and the influence of the greatest financial center, all have tended to keep New York the premier port, although the lesser rivals have, with uncontrovertible theory, provided better wharves, more efficient handling and superior railway connections. The war, wrecker of tradition and previous practice though it is, will hardly be able to remove this superiority, but it will certainly bring more close the performance and the promise of scientific development in the lesser ports.

Within a few months the amount of shipping from the Atlantic seaboard will far exceed the capacity of existing ports. Millions of dollars must be expended in the erection of warehouses, wharves and terminal facilities where none now exist. Necessarily all such works already in existence must be taxed to capacity and, what is most important, centralized control in Washington will dictate where and when the unprecedented freight will be shipped. No longer will the undoubted advantages of certain ports be outweighed by ulterior considerations pointing to New York. Every terminal will have to take just a little more than it can conveniently handle. The result will be that shippers will be trained to the use of the lesser ports so that when once more free competition between ports is resumed a certain part of the patronage will remain. In a year, if the Shipping Board's hopes are realized, the United States will be the second maritime nation in the world. No one or two ports can handle the business of the 14,000,000 tons of ships we should have by 1919. It behooves the citizens of every coast city, then, to consider the present-day conditions and forget that in the past the dreams of port enthusiasts too often proved to have the airy fabric of dreams when put into actual practice. Port development in the United States is at last a manifest necessity.

Paying the Penalty for Short-Term Garbage Contracts

AT A TIME when other cities and the Federal Government (at army cantonments) are getting a revenue from garbage, both Philadelphia and the District of Columbia have to pay increased sums on renewing their short-term garbage contracts. True, in both cases, the contracts cover both collection and disposal, but in these times of high prices for garbage grease and tankage, if Philadelphia and the District of Columbia were their own masters and used their freedom wisely, they should at least be able to offset the value of their garbage against increased collection costs. But the Pennsylvania Legislature and the Congress of the United States have not seen fit to authorize long-term contracts. The result is that garbage contractors can charge very much what they please. The evils of the year-to-year garbage contracts at Philadelphia and elsewhere were pointed out in *Engineering News* of July 3, 1913, where it was shown that under short contracts a contractor must either charge a high price in order to get his capital back in a few years or else rely upon political influence for contract renewals.

In 1910 and again in 1911, Philadelphia paid the Penn Reduction Co. $510,000 a year for garbage collection and disposal. The 1912 contract finally went to the same company for $278,000, after a low bid by a competitor and a readvertisement. For 1913, the contract went to the American Product Co. at the still lower price of $229,000. This company did not bid again, having lost money, according to reports. From that time prices have mounted steadily as follows: 1914, $288,588; 1915, $323,588; 1916, $373,588; 1917, $432,000; bid for 1918, $605,266, or $173,266 in excess of this year and $376,266 more than in 1913.

Today, Philadelphia has one garbage-reduction plant idle (if it has not been dismantled), while the owners of another one charge what they please for collection and disposal. Such is the result of one-year contracts.

Cleveland and Columbus, Ohio, own and operate garbage-reduction works, at a reported profit. New Orleans, as was stated in a recent issue, is just contracting for one, with an estimated profit of $100,000 or more a year, after paying operating expenses, interest, depreciation and royalties. New York and Los Angeles, on either coast, sell their garbage to privately owned reduction works. Other cities get money from their garbage by one means or another.

If American cities are not to be allowed to let garbage-reduction contracts for periods of ten years or longer municipally owned reduction plants will be the logical outcome.

Profiteering and the Industrial Unrest

PROFITEERING is a hard word, but the inescapable certainty remains that no few people and corporations are taking advantage of circumstances to line their own pockets even at the risk of forcing a dishonorable peace on the United States and its allies. In a selfish, half-blind way they reason that so vast are the amounts being expended and so seemingly careless is the Government, in its need for munitions of all sorts, that their individual grabbing will not affect the results and will pass unnoticed in the magnificent profligacy of war. They calm any self questioning as to the honesty of their acts by the antiquated economic doctrine that one-half of business is selling as dearly as possible. They would sincerely resent any imputation as to the ethics of their attitude, for it is true that yesterday's commerce was built on the conception that the need of the buyer was the justification of the price. But *caveat emptor* is a dead doctrine—and even though most acts are justifiable under the abnormal suzerainty of Mars, there is one single, overwhelming reason why now, more than at any other time, this doctrine should be reversed to make the seller beware. That reason is the more or less justifiable suspicions of the wage earner.

For labor will prove to be the entity we must learn to handle if victory is to remain on our side. Machines we must have, and capital likewise. Both are necessary ingredients in the dish on which our forces must feed to attain strength for battle. But labor is the essential, the indispensable. Without labor no use can be made either of capital or machines. That fact cannot be denied nor even evaded. Any action that may be taken by those in authority must be influenced by that realization.

Labor, then, must be made to feel that now, if *not* at other times, no one is to be permitted to take an unusual profit. The wage earner watches the prices of the food and clothing he must have increasing day by day. He learns that certain commodities are not to be obtained at any price. He is told by the press, which takes care to point out the significance of it, that vast stores of sugar are being hidden, and that food is dumped at the wharves to keep high prices steady. The billions of the Liberty Loans are beyond his understanding, and he wonders what portion of such vast sums go to the manufacturer as payment for value and what portion as profit over and above the figure his leaders have taught him are excessive even in times of peace.

The sad part of this is that it is partially true; that capital invested in certain industries is earning a profit far beyond reason. It is useless to affirm that the number of such instances is relatively small. One would be sufficient of an irritant to a class grown conscious of its strength and smarting under the memory of wrongs inflicted yesterday. The fact that the Adamson bill was passed under threat cannot be ignored.

Some thin-brained men are talking vaguely of the "conscription of labor." That is sheer absurdity. It is conceivable that the state can conscript wealth. That has been done—is being done now, in a measure. But wealth is narrowly held. It is urged, further, that armies are conscripted. But we are taught from infancy that there is no finer act than the sacrifice of one's life in fighting for one's country, while we have never been persuaded to believe that hard work is noble. Nor does work feed the enthusiasm with the stimulus of personal conflict, for machines do not fight back. Their operators must cajole them into yielding their maximum. The man on the lathe must be willing, eager to make the insensate arrangement of gears and screws and chucks produce the ultimate pound of finished material. This he will not do if his heart is sickened with the feeling and his mind poisoned with the thought that his employer is gaining unusual profit while he is constantly faced with harder necessity.

The *Engineering News-Record* believes firmly that individual ability deserves individual rewards. But war is a time when every custom, every tradition which impedes the coming of victory, should for the common good be coldly set aside.

Code Needed for Design Competitions

SUCH large-scale waste of engineering thought and effort as occurred in the Salem bridge case reported in this journal recently is unfortunate, to put it mildly. The immediate cause of the waste—official dillydallying with a construction problem—may support the belief that engineers were the innocent victims of circumstance, being lured on by empty prospects of distinction or a well-earned commission. But looking farther it is evident that the engineering profession itself is to blame. If a recognized code of practice in design competitions had been in existence, enforced by its general observance among engineers, the Salem case could not have turned out as it did.

As an instance of abuse of the design-competition plan the Salem episode does not stand alone. Such abuse is common enough that many engineers avoid design competitions altogether, knowing that the competitors are likely not to receive fair treatment. Often there are no definite advance requirements, no program, or if one exists it is disregarded when the judgment is made; still more often, properly qualified judges are lacking; the party calling the competition fails to assume any obligation, and, even if a prize or an award of commission is promised, the decision may be so handled—as at Salem—that all competitors are defrauded.

But the competition plan itself can not be condemned because of such abuses. It has held its popularity in Europe, and there as well as in America has proved its value. Indeed, many public-works constructions give grounds for the claim that we need to use the competition plan more often than we do.

Just as in the analogous case of competitive bidding, however, sound practice is the only preventive of abuses. Contract bidding is safeguarded by well-established law. There is no such safeguard for design competition and for that reason engineers must protect themselves; they must make their own law. In other countries they have done so, by formulating and enforcing a code of practice through their societies.

The individual engineer is powerless. Only joint action, through strong engineering societies, can give effect to a code of practice governing competitions. We may hope that following an awakening of society consciousness, now become apparent, this subject will be taken in hand. A single Salem case is enough to prove the need for action.

Hard-Surface Pavements for State Highways

In Selecting Road Types Engineer Must Recognize Today's Demand for Heavy Motor-Truck Traffic and Continuous Yearly Service

By Charles J. Bennett
State Highway Commissioner of Connecticut

IT IS the intention of the following discussion to suggest some thoughts on the development of state highway systems for heavy traffic. There is no intention to lay down any fixed rules or to draw any rigid conclusions, because our experience has not extended over a sufficient length of time to determine what is the exact and best solution of the problem of highway surfaces. Nevertheless, it is increasingly evident to all engineers that there are certain needs of traffic which are not generally met by the highway systems constructed at present. The first of these needs is for a road surface which is usable continuously during twelve months of the year for moderately heavy loads, and the second is the need for coördinating the design of the road and the design of the vehicle.

Considering the first, heavy loads should be able to use the road continuously, since heavy loads are carried for business purposes and on this account demand uniform service during the entire year. Pleasure traffic which, of course, constitutes the major portion of the traffic using the roads at the present time, adjusts itself to weather conditions and is virtually nothing during extremely cold weather. Motor-truck traffic and business traffic on the contrary, demand continuous service, and the highway surface and foundation must be designed to give this desired result.

At the present time the highways are used for long-haul freight under abnormal conditions, and our problem is not concerned particularly with these conditions, since it is thought that eventually the highway system will find its proper place in the scheme of transportation and the adjustment between railroad use and highway use will be made so that each will carry its proper share of traffic.

Co-ordinating Roads and Vehicles

Considering the second need, for coördinating roads and vehicles—the tendency at present is toward excessive loads on motor trucks. It seems that there must be a limit to the weights of vehicles, so that some relation between weights of vehicles and bearing power of road may be found. For purposes of discussion and argument, it is suggested that the limiting load on four rubber-tired wheels should not exceed 25,000 lb., properly distributed, so as to limit the load per in. width of rubber tire to 700 lb. In other words, for ordinary state highway traffic, a truck with capacity of 5 tons should be the largest allowed. Additional weight can be carried by the proper use of rubber-tired trailers under reasonable speed and weight restrictions. Given a reasonable limit for the weight and speed at which these vehicles may be operated, it will be increasingly easy, as experience extends, to design a suitable road surface for traffic needs.

In general, this discussion may be confined to those sections of country which are thickly settled manufacturing communities or to those areas where property values are high, due to concentrated agriculture or development of natural resources. It is evident that in these sections the highway traffic will be greater, yet the land and property will stand a sufficient amount of taxation to justify the expenditure necessary to secure the best highway surface.

Traffic Census as Guide to Road Type

With our present knowledge, it is impossible to figure accurately the advantage of one type of road construction over another, since no charge per mile of use is or can be made. The only criterion is the cost of annual maintenance plus the annual capital charge, and in the experience of the writer it has been found that all types of road are virtually in the same financial class, when the annual cost of maintenance plus the annual cost of financing first cost is taken into consideration. Consequently, the only method of determining what is the best type of road surface is the amount of travel and the duration and requirements of service. For this reason, a traffic census, both present and estimated future, is of value as an indication of the possible use of a road. This census should pay particular attention to classifying traffic and should take into consideration also the possible development of industry.

It occurs often that even with a traffic census, other information being available, it is impossible in the first improvement of a road to do more than grade and drain, leaving the hard surface to be added later as the traffic develops and more money may be expended reasonably on the road. For this reason, the budget of a state highway department should contain an item for reconstruction or replacements in addition to the ordinary construction and maintenance appropriations.

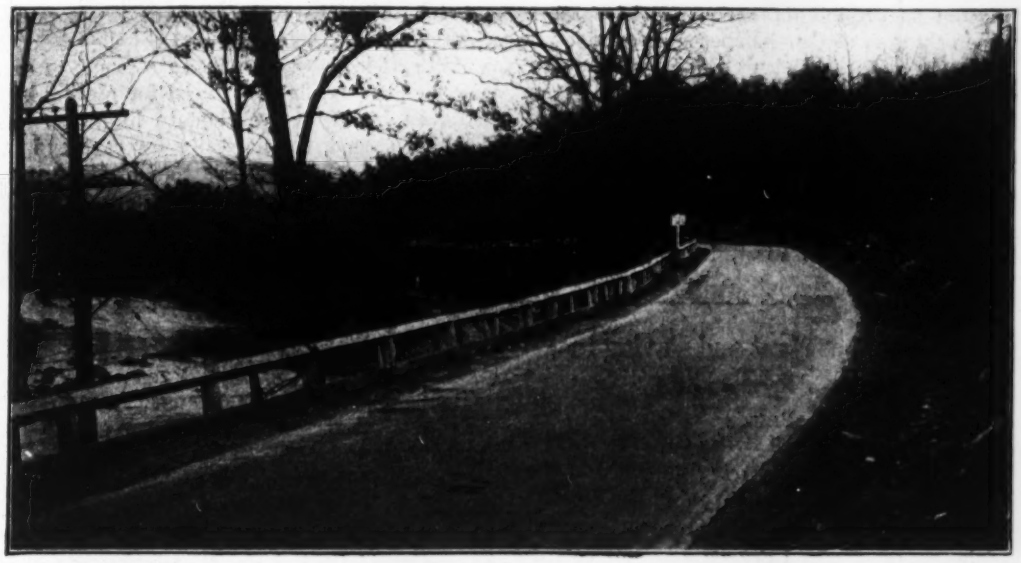
Another factor in the selection of pavement is that many highways connect thickly settled sections, yet run beyond these communities into the country, where the property values are not so high. Through traffic between centers forms by far the greatest percentage of the whole, and there is consequently a need of a uniform hard surface for the entire length between centers to meet the traffic needs. In such a section, it should be demonstrated easily that hard pavements are needed, not so much on account of the reduction in annual cost of maintenance, as on account of the need for safe, usable surfaces during the entire year. This makes it necessary, in the opinion of the writer, for the highway engineers to build rural or suburban roads in the same manner and with the same care as in the case of cities. Furthermore, a hard, clean pavement is always a delight to the motorist and certainly reduces the cost of maintenance and operation of the motor car. While the annual charge for capital invested is high, the cost of

surface maintenance is low and the general result in service is far ahead of that on the cheaper types of road which under heavy traffic in bad weather become difficult and dangerous to travel. With hard surface pavements, a uniformly good condition of surface may be obtained more easily.

In the selection of road types for state highways there are certain requisites which should be secured:

First: Proper foundation and drainage must be provided. This topic has been discussed exhaustively and can be left with the comment that in the case of hard surface pavements it would seem necessary to provide a foundation of portland cement concrete or of bituminous concrete, with the preference given to the former on account of the more definite knowledge of the action of the material under certain conditions.

Second: The pavement should be smooth and hard, so as to give easy traction to vehicles passing over it.



THREE-INCH SHEET ASPHALT PAVEMENT, 18 FEET WIDE, ON 6-INCH CONCRETE BASE BETWEEN WATERBURY AND NAUGATUCK, CONN., WHERE MOTOR-TRUCK TRAFFIC IS EXTREMELY HEAVY

Third: The pavement surface should be reasonably safe for operation of rubber-tired vehicles. Consequently, it should have a flat cross slope and be of sufficiently rough texture to give a grip for rubber-tired vehicles. It is safe to say that all hard pavements at present constructed are slippery under certain conditions, and here again is need for coöperation between road engineers and vehicle builders in securing a material for road surface or a material for tire construction which will do away with most of the difficulty which exists. Experience shows that by far the greater number of accidents to motor vehicles are caused during slippery weather by the failure of chains or non-skid devices to control the motion of the car, and, in passing, it may be said that the highway engineers are in duty bound to find a proper road surface, even at some additional cost, that the risk to the public will be reduced materially.

Fourth: The road must be of reasonable cost, which should be determined, not so much by the yearly financial cost of maintenance (although this is a prime requisite) as by a coördination between the needs of traffic as best judged by the engineer and the amount of money which can be put reasonably into the construction of the pavement.

In general, the width of these hard surface roads should be sufficient to carry at least two lines of vehicles, say not less than 18 ft., except through the centers, where there should be extra widths to accommodate necessary standing vehicles used locally. The shoulders or berms should be hard and reasonably safe to travel at moderate speeds when turning out to pass safely. Much has been said of the necessity of increasing widths of road to accommodate four lines of vehicles, but it would seem reasonable that before the expenditure for highway systems are doubled, there should be proper restrictions to the traffic using the road so as to make it unnecessary to spend this extra amount of money. In general, the tendency of automobile traffic has been toward unreasonable speed without regard to the results, but a proper regulation would make a two-line width of road satisfactory for the operation of four thousand vehicles per day even with the inevitable congestion at certain hours.

An endeavor has been made to prove the need for hard-surface city-type pavements on state highway systems outside of cities, and the chief problem which then comes to the engineer, as indicated above, is the selection of the best type of pavement. There is nothing so difficult at present for the engineer as to select the proper type of pavement even if he is left unhampered by outside influence. Virtually no data are available which would aid in determining mathematically the type of pavement to be chosen. The choice of pavement is generally a local engineering problem which can be worked out at the present time only by the use of judgment, opinion and data from a moderately small amount of experience, since the construction of these highway systems has been carried on only through a comparatively short time. It is evident that even with the best of intentions and the use of proper judgment, mistakes will be made, but the following general

ideas would seem to be of value in the selection of type of pavement. These are in addition to the general requirements stated previously.

In the first place, the road surface and material should be chosen so as to give the best service to the traffic using the road, with a reasonable first cost. On this account, so far as possible for portland cement concrete bases or surfaces or for bituminous foundations or surfaces, the local material should be used for aggregate so long as it gives a suitable result. Other types of surface, such as blocks, either brick, wood or stone, should be selected with a view to using the nearest source of supply, not only on account of the reduction of cost, but because of the need of conserving supplies of material and using everything which is available.

The Man with Something to Sell

Regarding the selection of type, the foregoing statement is written on the assumption that the engineer or authority in charge is left unhampered by outside influence. One of the most difficult things with which the highway engineer of today has to contend is the commercial interest which is striving to sell some particular type of pavement. As indicated above, no particular type of pavement has proved its worth sufficiently to be selected as better than any other type. There are two requisites in connection with pavement sales which should be demanded: First, honesty of public officials, and, second, a broader-minded attitude on the part of the pavement salesman, coupled with the same honesty that is demanded of the highway engineer. Given these two requisites, it would seem that a pavement could be selected wisely, with the result fair and just, not only to the community through which the pavement is purchased, but to the paving company or interest which by its endeavors has developed a satisfactory type of pavement. The writer suggests further a fair attitude on the part of paving interests, one toward another. The waste baskets of engineers have been filled with pamphlets condemning types of pavement. These circulars can be issued by competitors only. Every pavement which has been laid has been subject to failure in certain circumstances, and the old adage regarding glass houses applies to all. The highway engineers of today are getting together more and more information regarding the values of different types of pavement, and a blackguarding scheme such as outlined above, only reacts against the probable instigator, who can generally be located.

This article is written in an attempt to outline, in some simple way, first, the need for placing hard pavements on heavily traveled state highways in certain districts; second, the necessity for care and judgment in the selection and construction of these pavements; and, third, the need for honesty and fair coöperation in the dealings between pavement manufacturing companies and the public official who spends the money.

Separate Items for Plant and Paving in Small Town Asphalt Bids

By D. T. Pierce

Executive assistant, Barber Asphalt Paving Co., Philadelphia

ONE OF the difficulties in securing good bids from good contractors for asphalt paving in smaller municipalities has been the cost of transporting and erecting asphalt plants. For the relatively small yardages offered, contractors were not disposed to incur this expense. Furthermore, when they were willing to incur it, of necessity they added the cost of plant installation to their bids, a practice which resulted often in an apparent discrimination against the small town—that is, the small-town official was prone to think that there was discrimination or an attempt at a "hold-up," when he compared his prices with those of larger cities where asphalt plants were already established.

This difficulty has been overcome now by a simple expedient which can be applied in any case where the circumstances are such as to indicate its necessity or desirability. Credit for working out the plan belongs to the consulting engineering firm of Anderson & Christie, of Charlotte, N. C. It consists of calling for bids on the cost of bringing in a plant for proposed work. The clause in the specifications and proposals for 11,000 sq.yd. of paving in Mooresville, N. C., awarded in October, was drawn as follows:

"Item 1. In the space provided under this item each bidder on this section is to state a lump-sum price to be paid him to cover and provide for all expenses in connection with the transportation to Mooresville, N. C., of the plant to be used in the preparation and mixing of the materials entering into the pavement proposed to be constructed under this section, its erection ready for operation, the dismantling of the same upon the completion of the work and the reconsignment of the plant. Such sum is to be over and above and additional to any payments based on the unit prices stated under this section for the furnishing of tools, equipment, materials and labor for the actual construction of the finished pavement."

The bids under this item ranged from $700 to $1000, the equivalent of about 7 to 10c. per sq.yd. on the work immediately to be let.

The use of such a clause enables the municipality to tell exactly what it is asked to pay for pavement and what is added for plant installation. In the particular case referred to, it brought out three reasonably low bids from the best contractors available, namely, $1.27, $1.34 and $1.40 for sheet asphalt and $1.10, $1.19 and $1.25 for asphaltic concrete, all these bids being on natural lake asphalt and all, as given, exclusive of 4-in. concrete base which was bid at 80, 85 and 90 cents.

The plan devised by Anderson & Christie cannot fail to be of value both to small municipalities and contractors in all sections of the country, but particularly in those states where asphalt paving is spreading rapidly among small towns whose initial awards are necessarily limited.

New York Subway's Gains

The Interborough Rapid Transit Co., New York, in a bulletin says that 183,618 more passengers now ride daily on the company's lines than two years ago, and that every 24 hours 1,350,000 passengers are carried. Of this number 900,000 ride between 6 and 9 o'clock in the morning and 4 and 7 in the afternoon. Mention is made of the rapid growth of travel in the Bronx, which is increasing more rapidly, according to the bulletin, than any other section. The Bronx would rank sixth among the nation's cities if it were a separate municipality, the report says.

England Overcame Labor and Industrial Crisis by Intelligence

Highly Organized State of Both Workingmen and Employers Made Reasonable and Patriotic Agreement Possible—Labor Diluted and Women Used Successfully

Great Britain, a country much older than the United States and in many ways more experienced in the technique of industry and its attendant problems, has sent a special mission of her Ministry of Munitions to this country so that we, her ally, may benefit from a first-hand recitation of war-time industrial problems and of the methods of meeting them which have been developed and successfully applied during the past three years. Sir Stephenson Kent, member of the Council of the Ministry and director general of the Labor Supply Department; G. H. Baillie, chief technical dilution officer of the Labor Supply Department; H. W. Garrod, deputy assistant secretary of the Labor Regulation Department; and Captain Cyril Asquith, director of the artificer's allocation of the Labor Supply Department, have been in this country for over ten weeks, explaining the attitude of the Ministry of Munitions. The addresses, here presented in condensed form, were delivered at a luncheon tendered the mission by the Editorial Conference of the New York Business Publishers' Association on Nov. 13.

War Problems

BY SIR STEPHENSON KENT, K. C. B.

YOUR problems and ours differ. Anything that I or my colleagues may say, I beg that you will take not as advice or suggestions, but simply as a recitation of the experiences that we have had.

The organization of a nation's industries on a war basis is even more important than an army. The army is helpless if there is not organization of the industries and if the munitions are not forthcoming without interruption. Continuity of supply, and an ever-increasing supply are vital to success.

Industrial peace at home is a necessary accessory to the success of your army; without it, it is never going to dare to move. My government called together capital and labor; federations of employers and the executive chiefs of our trade unions. We differ from you in that respect. It is no exaggeration to say that in the engineering trade 80% of the labor is trade union labor.

My government therefore, had two ideal bodies to negotiate with: The committees of these federations of employers, who were fully representative of capital; and the trade unions officials, who fully represented labor. That conference ended in what is known as the Treasury Agreement, which was embodied in the Munitions of War Act. The principal features of that act are as follows:

In the first place, the Minister of Munitions definitely limited the profit that might be made in any establishment that was engaged in the manufacture of munitions.

In the second place, the wage of the labor in those controlled establishments was fixed; it was made quite clear to the trade union heads and to labor generally that there would be no fluctuation or variation in the wages of that labor, except by express consent of the Minister of Munitions, and that he would not give his consent to any such variation unless an overwhelming case was made to him.

The state, then, fixed the profit and fixed the wage. Capital and labor and the government definitely agreed on the principle which, I think, is essential; that a nation's need is not the opportunity for capital or for labor to make money. Having done that, the state realized its duty in regard to the labor, whose wage it had limited.

The Committee on Production was to ascertain what, if any, the increased cost of living amounted to and to issue a national award so as to meet the increase in the necessities of life. That committee meets three times a year and has the necessary statistics laid before it, receives representations from trade unions and from any one else who should have a voice in the matter, investigates the case, then gives instructions that this labor should receive so much extra per week to meet that increased cost. That is paid by the employer and is recoverable from the state.

The third point was the illegality of strikes and lockouts. In peace a lockout or a strike was a matter between the employer and his employees; in war time it is a matter of national concern. The state would not permit, through obstinacy on the part of the employer or his employees, a factory upon which the army was very largely dependent for munitions, to remain out of work. And so, in this Act, it was laid down that any lockout or strike is illegal, and if any one incited the men to go out on strike, or if the employer deliberately locked out his employees, he laid himself open to the maximum penalty of penal servitude for life.

The trade union leaders agreed to waive all restrictive practices on output or from engagement of labor on war work, for the period of the war. The government pledged itself to restore the pre-war conditions on the advent of peace.

The act has, on the whole, worked well. We have

had stoppages, we have had strikes, but they have not been of very great length or of very serious moment. If you take into consideration the very long period of strain that our workmen have suffered under, this is very surprising. In the early days of the war we worked hours that are really disgraceful: One hundred and twenty hours in the week in some establishments. A hundred hours was quite common. That went on for a period of some months.

After this long period, it will be easily appreciated that because of war-weariness any little grievance becomes a matter of very great importance. It is a very fruitful soil for the pacifist, for the professional agitator, for the I. W. W. to work. It redounds enormously to the credit of our labor that we have managed to get through with continued industrial peace.

The Ministry of Munitions is given the solving of all the problems that deal with labor. *These matters are not left to the individual employer. We do not permit one employer to settle some little dispute in one way, another employer a similar dispute in another way. We try and get some definite, broad policy laid down, and then deal with these matters on that policy throughout the country.*

We have a very considerable staff whose duty it is to act as the eyes and ears of the Minister of Munitions. It is their function to know of any possible cause of dissension in any industrial center in the country, and to deal with that cause of dissension before it becomes a dispute.

We have the theory that in war time prevention is one million times better than cure. We have, to a certain extent, been successful, but it is a very arduous business today, because of that fatigue to which I referred

We take the view that today, above all other times, it is absolutely vital to exercise economy from every point of view. Economy from the point of view of food —yes; but economy from the point of view of the materials that are essential to the winning of this war, economy from the point of view of the use of man-power.

We look upon it as a very serious crime if any of these raw materials which we never have a sufficiency of, is used for any purpose other than to help to win the war. We look upon anyone who misuses the skill of any mechanic or any citizen as a criminal.

We have a great number of engineers of the highest qualifications, whose duty it is to investigate the use of man-power in manufacturing establishments. If they find any employer having a skilled workman doing work that somebody who possesses less skill could do they move him on to some work that he should more properly be performing.

That is absolutely vital, and I think that you, in no very long period of time, will also find it vital. This war is primarily a war of mechanics. There is no country that is today at war that has a sufficiency of skilled mechanics.

With every conceivable article of munitions that we send to the army, we have to send some skilled mechanics; we have to deplete the skilled man-power that remains. The better we supply the army, the more difficult our problem at home becomes.

In the early days employers were loyally anxious to do everything they could to assist the government in getting the biggest output of munitions at the earliest possible moment. They thought that it would be of assistance to the country if they accumulated as large a number of skilled mechanics as they could. Of course any such habit as that leads very rapidly to the most vicious of conditions. The man whose labor is being taken from him robs somebody else; there is no finality in it. You get unrest of the worst description. Your labor is always looking to see if it can't find some other employer who will offer it a still higher wage than it is at that moment receiving.

We made it an offense for any employer in the engineering industry to offer inducement to labor engaged on similar work. We also gave the Minister of Munitions power to restrict and regulate the employment of labor in any establishment. If the Minister was dissatisfied with the way any employer was either handling his labor, or was making use of his labor, he had the power to lay an embargo on the engagement of labor in that particular firm. This brought things to some sort of state of order. If we do that in war time, why don't we do something for our country in peace time?

It is an old truism, but people have the government they deserve, and the business communities of the world have got to take a bigger interest in their government in peace time and not leave it till war time in future.

It is absolutely impossible to exaggerate the importance, the overwhelming importance, that labor plays in war. Without labor, without industrial peace, this war cannot be won. Should you fail to solve those problems it will react, and react very seriously, in England. We look to you with a great deal of confidence. We appreciate how enormous those problems are, but we are happy that you will solve them and solve them on the right lines.

Dilution of Skilled Labor and Substitution of Women in Industry

BY G. H. BAILLIE, ESQ.

OUR two schemes for meeting the shortage of labor have been the dilution of skilled labor and the substitution of women for men. Both of those schemes were contrary to the trade union customs and practices as they were before the war, and we have been able to put them in practice only on the basis of the agreement between capital and labor, to which Sir Stephenson Kent referred.

One provision of that agreement had the effect of abolishing all trade union customs and practices during the period of the war. The agreement referred to work on munitions only. Our employers made use of those agreements in various ways. First an unskilled worker was brought into the plant to do an easy job. The man so displaced was put on the more skilled work, and the man displaced was again promoted, and so on until there had been an upgrading of skill throughout the whole shop.

Another method adopted was to draw unskilled men from the non-essential trades, unskilled men who were either over military age or of low medical category. Watchmakers were brought into the tool rooms to do gage making. Our building industry was largely closed

down and we took sanitary plumbers from there and trained them up to do lathe turning for our explosive factories. We also drew from the building industry carpenters and joiners and set them into the shipyards to act as shipwrights and shipjoiners. We took mechanics, textile mechanics, from the textile industries, accustomed only to rough work, and trained them up to the better work of munitions. A third way was by confining the fully qualified mechanic to the highest forms of skilled work. If the mechanic normally had been on a job that could be split up into two or more parts of varying degrees of skill, the mechanic was confined to the part requiring the most skill, and we trained up men and women to do the lesser skilled parts.

Those schemes we called the "dilution of skilled labor," and it helped us to a great measure in dealing with our shortage of skilled labor, but before long practically all the useful men in the non-essential trades had either been drafted into the army or had gone into the munition plants, and to meet our continually increasing demands for munitions, we had to rely upon the women.

It was agreed that a woman undertaking work which previously had been done by a skilled mechanic, should receive the same day rate as the skilled man; if she was on piece work, she was to receive the same piece rate. Only on unskilled or semi-skilled work did the woman's wage differ from that of the man, and then her wage was regulated by an order which fixed a minimum wage at two-thirls that of the unskilled man.

As a result of the good wages that women have been able to earn on munitions work, we have never been short of applicants for any kind of work, and our employment of women at present is limited only by our facilities for training them. They have attracted to munitions work a class of woman who has had a fairly good education, and we have found that she is capable of far better work and can more easily acquire skill than the type of woman that previously had been common in factories employing women.

We have now on munitions work only over a million women. Since the Minister of Munitions began to urge the employment of women about two years ago their employment on munitions has been most striking, both in the extent to which machine shops are staffed by women and in the difficulty of the work on which they are engaged. We have a shop on five-inch shells in which only 6% of the hands are men; and in the machine shop all the tool setters and all the charge hands are women. And we have another shop on six-inch shells in which the proportion of skilled mechanics is one to every fifty women. That shop for output is one of the best shops in the country. On the average, about 80% of the hands in the shell, fuse and similar plants are women—a very important result from the point of view of manpower.

In our largest explosive factory, making cordite, guncotton and certain other explosives, we have 15,000 hands, and of those 11,000 are women. On filling work on small shells, and on fuses and similar articles, percentages well over 90% are reached. On the larger shells the percentages are, of course, lower.

Coming to more highly skilled work, the percentage of women employed is, on the average, a good deal lower, but we have a shop engaged on breach mechanism for howitzer guns in which every machine tool is operated by women who harden and grind their own tools. We have women making screw gages, and the only skilled assistance they receive is that a toolmaker checks the setting of their chasing tools. For that class of work training is required. On the work we have found that no special training is necessary.

The plants engaged on skilled work have little work of a simple character on which the women can gradually acquire skill. To meet that difficulty, the Minister of Munitions has equipped a number of training schools where, however, we do not attempt to give any general instruction. The women are taught to use the foot rule and the micrometer, but after that their training is specialized and they are taught to do a specific job on a specific type of machine. In that way they can acquire considerable skill in from six to eight weeks.

But the larger proportion of the training has been done in the plants themselves. They have started schools in which they have trained women in the use of their own types of machine and when they supply a machine to a customer, they are prepared to send with the machine, as an item in the list of accessories, one or two women who have been trained to use it.

In 1915 all our employers regarded the introduction of a woman into a machine shop as one of the horrors of war—about on a par with Zeppelin bombing and the shortage of sugar. Nothing has been more striking than the change of our employers' attitude toward women in the past two years. If there is now a question between taking on a woman or an unskilled man, the employer has no hesitation at all. The woman has been found to be a better and more conscientious worker than the unskilled man that is available in our country now. And the woman has been found better able to acquire skill rapidly. When it is a comparison between a woman and a fully qualified mechanic, one cannot expect the woman to be so valuable an asset as a man who has been four or five years at his trade. But now the only skilled men we can scrape out of the less important munition factories are of so poor a quality that it is not uncommon for an employer who requires extra staff to take on women and train them himself rather than apply to the Minister of Munitions for the poor quality of man that he knows is all he will be able to get.

I am afraid, gentlemen, that these results of our experience may seem rather far off for conditions now obtaining in your country. But I believe that you are no better off for skilled men than we were at the outbreak of war, because you have adopted the policy of the unskilled operative to a far greater extent than we did in England. I believe that you will find yourselves following our experience. I hope that the results of our experience may prove of some service to you.

Regulation of Trade Disputes

BY H. W. GARROD, ESQ.

WE, IN England, haven't a method, for there is no method, of dealing with trade disputes. But we have had, in all, only three labor disputes since the war began, which could be called serious. One of those lasted ten days, and neither of the other two lasted as much

as a week. They were serious to us. They might not be thought serious elsewhere.

Secondly, I'd call attention to the fact that since the war began we have had no strike which has arisen out of a demand for higher wages.

Thirdly, we have had no dispute in which the responsible officials of the trade unions have not stood loyally by the government and against their men. They bargained when we first passed our Munitions of War Act that there should be no strikes, and in every instance they have used all the influence that they possessed in order to keep the peace.

In the three serious disputes which I referred to just now, and in the great majority of the lesser disputes which have occurred, the men as a whole have not been behind the strike. In the three instances mentioned, at any rate, the work was done by a small band of local trade union officials who were in revolt, not against the government, but against the central officials of their own union, and who were also deeply tinged with pacifism.

But since we have been in this country, a period now of nearly ten weeks, we have been witnesses from a distance of a very considerable number of trade disputes which have been serious, and, in some cases, prolonged. If one-eighth of the industrial troubles of this country in the past two months had taken place in England, over the whole period of the past two years, we should long ago have been compelled to sue for disgraceful peace.

Supplying Skilled Artificers for the Army and Navy

By Captain Cyril Asquith

THE specific work in the Ministry of Munitions which it is my duty to discharge consists in the provision of skilled artificers for service in the technical branches of the army and navy.

Artificer is the army name for a skilled machinist. I think it would probably surprise you to know how large those demands are. The technical branches of the army comprise altogether about half the total personnel. Those crops do not consist wholly of skilled men, but they consist of skilled men to a greater or to a lesser extent. For instance, as we left England a demand was presented by the War Office for 40,000 skilled men to work on the railways behind the lines in France, and about three or four weeks ago we heard that a further demand for 15,000 highly skilled machinists had been presented.

In common with practically every other European power, we made the mistake in the first year of the war of permitting the enlistment of highly skilled machinists who would have been much better employed upon munitions or in technical branches of the army.

At present we attempt to meet these demands, so far as possible, by pointing out to the war office any skilled men whose unit we have been able to trace, and recommend the War Office to transfer them to a technical branch. The only other source is skilled men working on munitions.

In withdrawing such men from the more important classes of work, output suffers correspondingly, and we can't afford that. Nevertheless, the greater the output of munitions, the greater the number of skilled artificers who are needed to maintain them in repair at the front. A rather vicious circle.

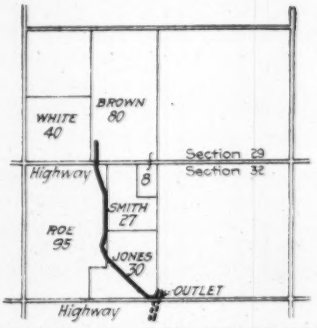
We look to you, gentlemen, to avoid that mistake, and we look to you with the utmost confidence. We know already that your War Department has taken steps to avoid it. It is about the only mistake we think you should avoid. We have been immensely impressed with the enormous reservoir of ability, energy, and resource which America contains. It gives us high hopes of a certain and not far distant victory.

A Method of Allotting Farm Drainage Ditch Maintenance

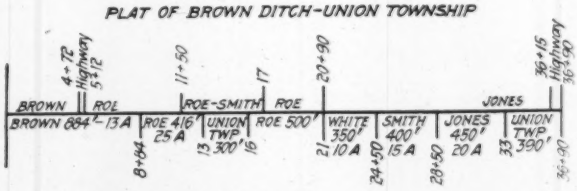
By R. L. Longshore

Decatur, Ind.

THE TASK of allotting the maintenance of drainage ditches is tedious and exacting, especially in sections that are well ditched. In Adams County, Indiana, there are over 200 ditches, varying in length from



PLAT OF BROWN DITCH—UNION TOWNSHIP



PLAT SHOWS PROPERTY BENEFITED AND LOCATION OF DRAIN—LINE REPRESENTS LENGTH OF DITCH—ABOVE ARE SHOWN THE PROPERTY INTERSECTIONS AND BELOW THE LENGTH TO BE MAINTAINED BY EACH OWNER

one-half mile to 14 miles, and it is necessary to re-apportion the maintenance of the ditches, to the extent of 50 to 75 each year. While there is a state maintenance law, it has proved so unsatisfactory that it is changed by nearly every session of the Legislature.

In general, the law provides that the drain be allotted in sections to the landowners assessed for its construction. This work is done by the county engineer, who as far as possible allots the maintenance work to the farmers so that each will be responsible for the section of the drain passing through his farm. After the allotment has been published, a hearing is held and complaints are adjusted. The landowners then become responsible for the sections until a new allotment is made.

A method which has given much satisfaction has been developed for performing this work. The drains

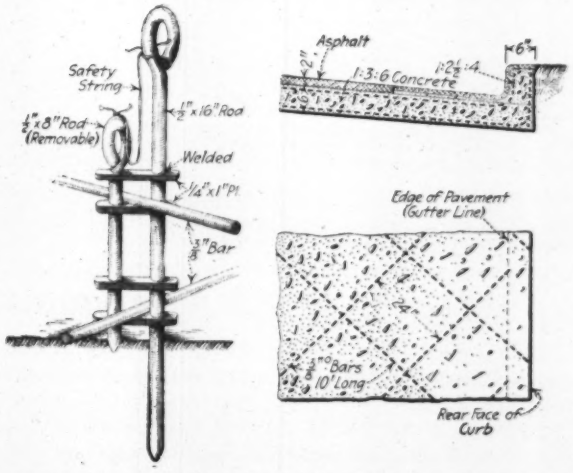
are staked and divided into 100-ft. sections, the field notes showing land-line intersections as well as the condition of the various sections. All factors that tend to make maintenance difficult, such as deep cuts, timber stretches, etc., are noted and are taken into consideration in the allotment.

A plat of the land affected is then made, to show the ditch and the areas benefited in each tract. The drainage ditch is then laid out as a straight line to a scale of 40 ft. to the inch, and marked to show the land-line intersection above. The sections to be maintained by each property owner are then laid off below the line. A graphical method is thus provided which makes it easy to compare the sections as well as their locations, and in case of necessary adjustment it becomes easy to visualize the proper shifting.

Concrete Curb Rests on Reinforced Pavement Base

THE WAXY GUMBO which underlies much of Houston, Tex., dries out rapidly in the summer and leaves cracks 2 in. or wider parallel to the curb and generally about 2 or 3 ft. from it. As a result, the ordinary separate construction of curb and base permits the curb to get out of alignment very easily. Especially is this so when the soil becomes saturated again. So harmful is this action that in one case the base of a 3-in. wood-block surface was found at the top of the curb, although probably settlement of the curb had pushed up the pavement somewhat. To avoid this occurrence, the base is reinforced by diagonal rods 10 ft. long, which are bent up into the curb proper. This makes the base of the curb an integral portion of the pavement, and separate settlement of the curb becomes impossible.

One of the contractors has devised a special support to aid in the placing of the reinforcing of this type of pavement. One of these supports is driven into the sub-grade at every other intersection of top and bottom rods. Since the top rods are all laid at one angle, and the bottom ones at right angles to these, their support in this manner is a very simple matter. After the concrete has been placed the supports are removed without great difficulty.

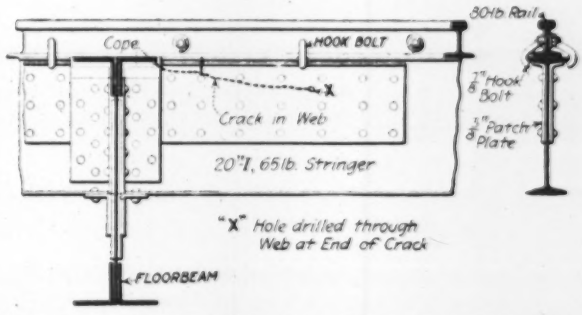


SIMPLE DEVICE SUPPORTS REINFORCEMENT UNTIL CONCRETE HAS BEEN CAST—STEEL RODS TIE CURB TO CONCRETE BASE OF PAVING

On account of the extremely flat grades, and a rainfall which amounts to 50 in. per year, the gutters have a 2-in. drop from toe to heel instead of the usual 1-in. drop. Pavements in Houston are planned and laid under the direction of E. E. Sands, city engineer, who also has supervision of the maintenance of all guaranteed pavements.

I-Beam Web Cracks Under Rocking of Rails Clipped to Flange

HORIZONTAL web cracks developed in more than 200 I-beam track stringers carrying the rails directly over and in line with the stringers for some ore bins in Birmingham, Ala., and were repaired by patches riveted over each crack. The details of the construction and repair are shown in the accompanying drawing. The stringers are 20 in. 65-lb. I-beams and carry E-50 loading on the 80-lb. rails, which are fastened to the beam by hook bolts placed alternately as shown.



ROCKING ON RAILS CRACKED I-BEAM WEB, WHICH WAS REPAIRED BY PATCH

The crack in each case started at the point of cope and extending from 5 to 30 in. along the beam. The failure is thought to have been caused by the sidewise rocking of the rail and beam flange under passing loads which produced bending in the web of the beam. The sharp corner cut made in coping furnished the necessary start for the cracks which traveled almost horizontally along the beam.

As it was not possible in this case to provide other means of supporting the rail on the beam, a small hole was drilled through the web at the end of the crack to prevent further fracture and a ⅜-in. plate, bent to fit snugly under and support the flange, was placed on each side of the web as shown. This method of repair has been proved by many months' service to be satisfactory.

The case is reported by R. E. Parker, structural steel designer, Birmingham.

Education Prevents Stream Pollution

Visitors to San Antonio Canyon, the source of water supply for Ontario, Calif., receive from the attendant of the toll gate at the entrance to the canyon a printed warning against contamination of the stream. Although large numbers of people visit the canyon, the State Board of Health reports that "the supply appears to be relatively free from pollution."

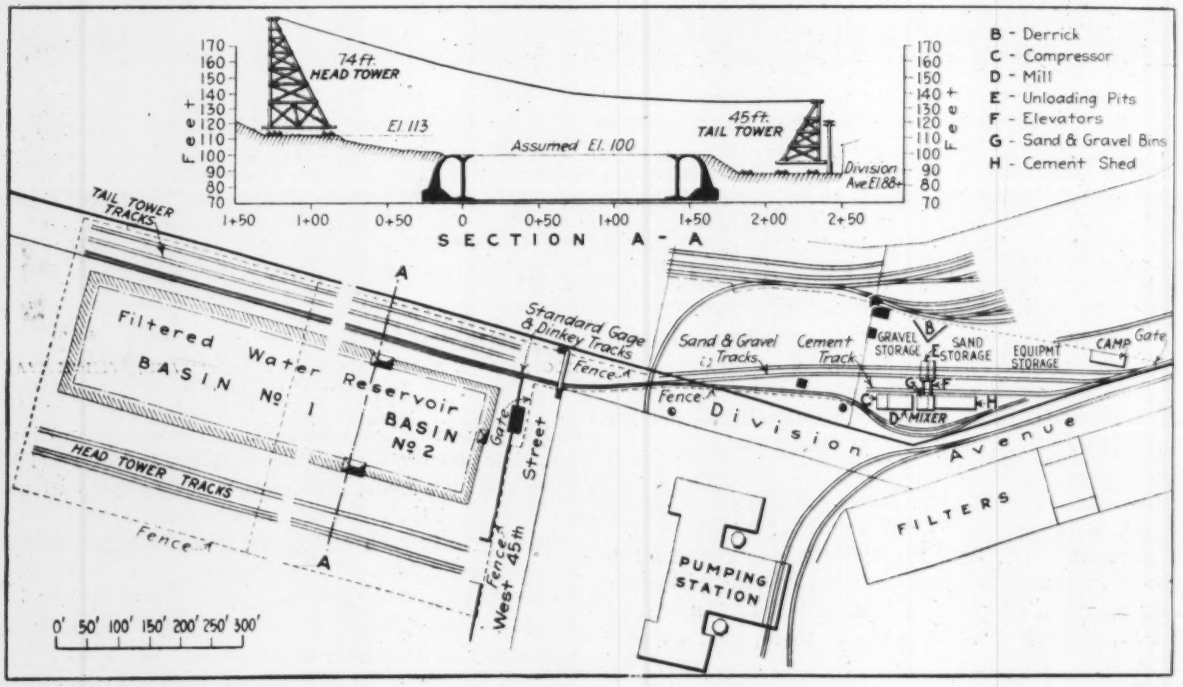
Cableway Handles Relining of Cleveland Water Basin

Filtered Water Reservoir Reinforced with 18,000 Yards of Concrete Placed Without Erecting Construction Plant on Roof, Section of Which Collapsed Last Year

TWO things which stand out about the work of placing 18,000 yd. of heavily rainforced concrete in repairing clear-water reservoir of the Cleveland filter plant are the use of a traveling cableway, spanning the basin, which handled all the hoisting work, and the location of the concrete plant 1000 ft. from the nearest end of the work on private property at an elevation considerably lower than the roof of the basin.

The first was dictated by the contractor's responsibility for the safety of the basin, a small section of which collapsed in the summer of 1916. The location of the smaller basin containing the influent and effluent conduits.

The work of relining included the placing of a new reinforced-concrete floor on top of the old one; new reinforced-concrete sidewalls, varying in thickness from 20-in. at the base to 8 in. at the top, between curved beams at 15 ft. 9 in. intervals inside the old walls; the jacketing of the old 20-in. square columns to form 32-in. diameter circular columns, with spiral reinforcement; and the placing of a new 6-in. reinforced-concrete roof on top of the existing roof. The new roof is



CONCRETE PLANT SITUATED ON PRIVATE PROPERTY 1000 FEET FROM BASIN AND RELINING CARRIED ON WITH CABLEWAY

concrete plant was selected for several reasons. Rail delivery of materials was desired. The filtration plant is located at the foot of a high hill near the old Cuyahoga river bed. The rail approach is along the river bed at a lower elevation than the plant, while the street approach is from the hill. Because of existing buildings it was not possible to set up the concrete plant close to the basin and still along the line of the railroad. It was also deemed advantageous to have at the work storage space not located on the city property, to which the contractor's equipment could be moved as soon as it was released, without waiting for cars or for a decision as to where it had best be shipped.

The repair work done virtually consisted of building a new basin in and around the old one. The reservoir, which includes two basins; the smaller, of about one quarter the capacity of the larger, is of the ordinary groined-arch construction, with the outer walls of the bonded to the beams of the new sidewalls by reinforcement which extends through rectangular holes cut in the old roof. In addition, the old conduits within the walls of the smaller basin were bulkheaded and two new reinforced-concrete conduits constructed within the basin. The old conduits were connected to the new with special ingot iron sections, and the expansion joints of the walls were provided with plates of the same material. Approximately 900 tons of reinforcing steel were used in this work.

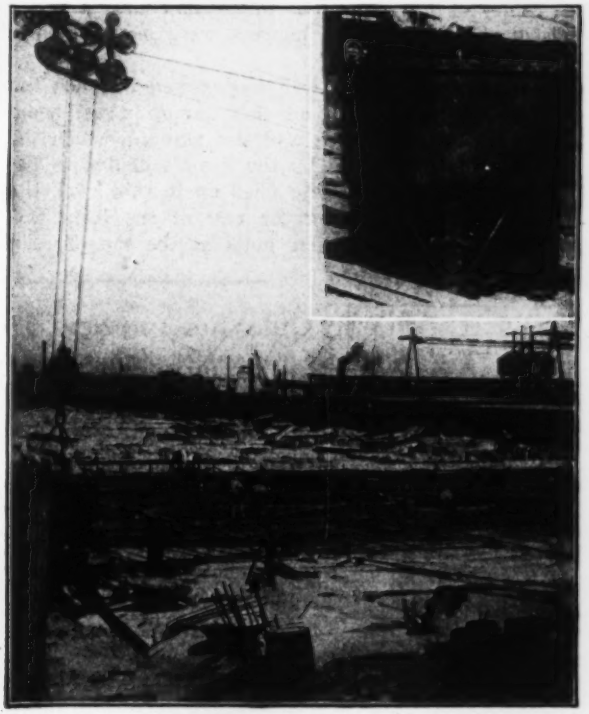
The area to be covered was roughly 950 x 200 ft. It was not permissible to erect on the roof of the basin an elaborate spouting plant and the additional equipment required to handle the reinforcing steel, ingot-iron conduit connections, forms and old concrete removed. This would have involved an unnecessary risk on the part of the contractor. Therefore, a traveling cableway of 15 tons capacity and 360 ft. span was erected, with the 75-

HEAVY BRACING REQUIRED FOR WALL FORMS

ft. head tower traveling on a terrace on the hillside above the basin, and the 45-ft. tail tower traveling on Division Ave. at an elevation 12 feet below the roof of the basin. Between the tail tower and the basin is the standard gage track for the delivery of material, which by the addition of a third rail was converted into a narrow gage track for the delivery of concrete. The two towers are moved simultaneously by a cable at each and can move the length of the basin in a few minutes.

The concrete plant, as stated above, is located on property leased by the contractor from the railroad. Sand and stone are received in cars on two tracks and dumped into two track bins capable of holding several carloads. Beneath these are two belt conveyors, one to feed the stone and one the sand bucket elevators, which in turn deliver the materials to overhead bins. From these bins the 2-yd. concrete mixer is charged by gravity. The storage capacity of the bins and track hoppers is about 450 yards.

Because it was necessary to dump the concrete from the mixer into a 5-yd. hopper from which the 3½-yd. concrete buckets could be filled rapidly, the mixer was mounted a considerable distance above the ground, as shown in one of the views. It was provided with an elevating loader in order to permit the charging bins to be set much lower than would be necessary for direct feed into the mixer. In addition to the capacity of the bins, material was unloaded from either the track hoppers or from the cars direct by a derrick and clamshell bucket and piled on the adjacent ground, providing a large additional storage space. The cement was handled in cloth sacks either from a shed of about 20 cars capacity or direct from the cars into the charging hopper of the mixer.



CONCRETING THROUGH HOLES IN ROOF—INSERT SHOWS CONTRACTOR'S BUCKET

COLUMNS POURED THROUGH THREE-INCH HOLES IN ROOF

The smaller basin was completed first. The floor was poured first, then in order the central sections of the four walls, the corners with the conduit connections, the conduits and lastly the roof. The columns were poured as rapidly as possible after the floor was completed. In the larger basin the floor was poured in sections of approximately 350 yd. each, the walls in six panel sections of about 180 yd., the columns in groups of 20, and the roof in sections of 350 yd. each.

For the smaller basin a complete set of forms was required for each wall section, and these could be used only once. In the larger basin two sections of forms were provided for both the north and south walls, each

of these sections being set four times to include the corners and west wall. The forms which were used in the smaller basin for the dividing wall were used over in the larger basin, after alteration. There were 26 wall settings, all told. The wall and conduit forms were of wood. The former required an elaborate system of bracing against the new columns, as it was impossible to use wall rods or ties. The circular column forms were of No. 10 gage steel built according to the contractor's design.

The placing of the concrete presented an interesting problem. All the concrete was brought from the mixer in 3½ yard buckets, two dinkeys, hauling two flat cars each, being used to transport the buckets. For pouring the floor a large number of 20-in. holes were cut in the old roof of the basin. Through these openings flexible chutes extended to the floor of the basin. The concrete was dumped from the concrete buckets by the cableway into hoppers to which the chutes were attached. The chutes and hoppers were moved by the cableway.

The lower half of the wall was poured in much the same way, openings being left half way up in each beam and in the center of each wall slab through which the concrete was discharged by the flexible chutes as before. When the walls were filled up to this level, the openings were closed and the rest of the form was poured through rectangular holes at the top of each beam. To aid in filling the curved upper section of the wall slab three 10-in. holes per panel were provided in the old roof at the extreme top of this slab. It was possible for men to work within the wall forms until the halfway mark was reached, and in the beams for their entire height.

The columns were poured through four 3-in. holes drilled through the old column cap. Pounding of the steel forms with wooden mallets was the only possible method of insuring a dense concrete. This, incidentally, is stated to have proved very effective. The roof concrete was deposited directly from the concrete buckets. It was possible to obtain a rate of progress on the walls of 40 yd. per hour and on the roof of 70 yd. per hour.

All told, more than 500 yd. of old concrete had to be removed to carry on the work. This included four panels of roof. Through the openings thus made forms, reinforcing steel and materials could be lowered into the basin. The work was considerably hampered by unforeseen difficulties in the fabrication and delivery of materials, but was in readiness for service before the end of October.

The work was done for the City of Cleveland by the John F. Casey Co. under the direction of Ottamar Stange, of that company. The construction details were planned by E. J. Gass, engineer of the contracting firm, while the work was in charge of H. T. Hammer, superintendent.

Effect of Priority Order No. 2 on New York State Road Construction

By H. E. Breed
First Deputy Commissioner, New York State Commission of Highways

THE embargo went into effect Nov. 1. During October there were shipped for the use of our contractors working on New York State roads about 36,000 tons of stone, gravel, etc. As November marks the close of the building season, there would have been a normal decrease to about 20,000 tons for this month if the embargo had not been in force. Under the embargo the shipments have been virtually nil.

To some of the work that can be carried over without detriment until next year, this makes no serious difference. True, the public must wait a year longer for its roads, and commerce, especially farm commerce, will suffer. The contractors suffer, too, because the cost to them is increased and their plant is held over.

More serious is the damage where the bottom course has been laid, and the work then stopped for lack of the materials under embargo. Large additional expenditures will have to be made next year to put this work in shape again for finishing.

There are at the present time in New York State about 220 live contracts for whose completion 500,000 tons of imported material (stone, gravel, slag and sand) will be necessary. If the embargo is continued in force throughout next year, all work on many of these contracts will have to stop.

The embargo also seriously affects our repair work. Heretofore at this time of year, after the commercial season is over, it has been the custom of the department to order materials and deliver them alongside the roads in readiness for early repair work in the spring. With the present possibility of not getting them until spring there will be a serious delay in maintenance work that will necessitate the roads being torn up later than usual in the season and thereby interfere sadly with traffic.

Conditions are changing so rapidly from day to day that no action affecting the contractors has been taken by this department. Any scheme of operations that might be outlined to alleviate conditions today would probably be insufficient tomorrow. Neither has the Commission of Highways any legal right to involve the state in expenditures other than those obligated by the contracts now in force.

[For other opinions on the effect of Priority Order No. 2 see *Engineering News-Record*, Nov. 15, p. 916.—Editor.]

Ore Found Under Hibbing, Minn.

A 40-acre tract of land in the heart of the City of Hibbing, Minn., will be mined for iron ore by the Oliver Mining Company.

According to the plan, a dozen square blocks in the center of the city, in which are located the leading hotels, the city hall and virtually all the business houses, are to be razed.

It is planned to move the business center of the city to Alice, a suburb south of Hibbing, and it is anticipated that the purchase of the property and the moving of the buildings to their new sites, if accomplished, will cost the mining company more than $1,000,000.

The property owners in the section of the city under which has been located one of the most valuable veins of ore on the entire range will be paid for their property at rates fixed by mutual appraisal.

Establishing the Railway Terminal at Camp Dix

Utility and Speed of Installation Being Imperative, Both Design and Construction Methods Were Quite Different from Ordinary Practice

By W. F. Rench
Superintendent, James McGraw Co., Wrightstown, N. J.

METHODS quite different from those used in ordinary railroad construction had to be employed in building the terminal layout at Camp Dix, the army cantonment located near Wrightstown, N. J. There was need for both rapid progress in the initial stages and a high class of work. The general plan shows a layout in which utility and not precedent was the guide, while the construction methods to be described show as much originality.

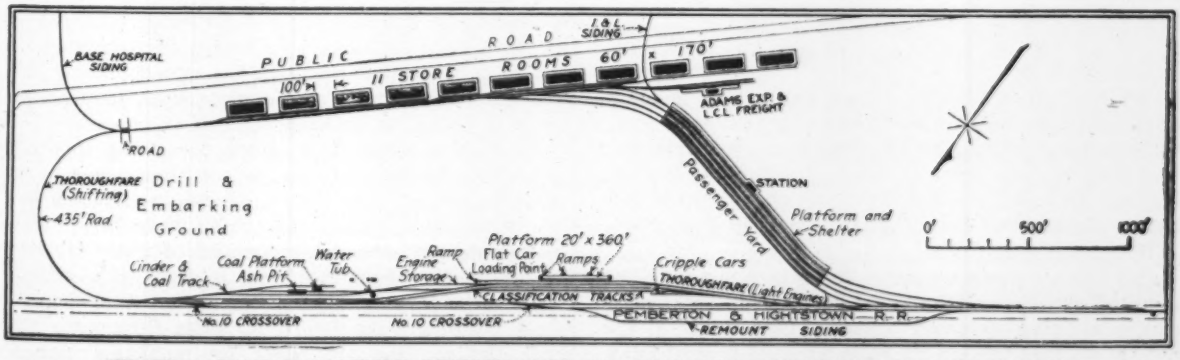
The transportation problem at Camp Dix was virtually the same as at all the other camps. The inside transportation was planned to be done by motor trucks plying between the stations and storehouses over macadamized roadways. The outside transportation was entirely dependent upon service through the railroad connections. The traffic movement at the Camp Dix terminal, being concentrated, is necessarily of an intensive character. The contour of the ground not being entirely favorable, the track arrangement had to be planned with full consideration of both the engineering and the operating features. The plan shows the completed layout except for a siding which serves the garbage incinerating plant, located half a mile from the camp, and the magazine siding somewhat farther removed, through which ammunition is received. The system of tracks is coördinated for the movement of troops and supplies, and especially provides for alternative routing. It will be observed that the yard for engine preparation and dispatch is particularly comprehensive. The presence of a loop track not only facilitates the turning of engines and trains, but also permits the handling of troops, both arriving and departing, without shifting of the train.

The traffic through this terminal amounted during the final weeks of construction to 100 carloads daily, besides four scheduled passenger trains into the new station and many special trains carrying mechanics, visitors and soldiers on leave. This movement required the use of two drills working day and night. The cars of material for the construction of the barracks were classified and delivered in rotation through the siding marked I. & L., which traverses the cantonment and is about two miles in length. It has spurs leading to several of the sections of the camp, there being five spurs in all. The loads for the base hospital reach that point through the siding appropriately indicated on the plan. The remount siding on the opposite side of the main line is for the receiving and reshipment of horses. The Adams Express station and adjacent less-than-carload delivery are conveniently located for the cutting out of cars in such traffic from the passenger trains. The three spurs serving the eleven storehouses are designed to be entered with equal facility from the passenger system, or direct from the main line via the loop. The classification tracks simplify the drill operations for the entire yard.

A feature of the terminal is the considerable amount of switch work involved, which had to be done by a class of labor inexperienced in such construction. There was imperative need for immediate provision of siding facilities to the point where the I. & L. siding diverges, to avoid the haul of 1½ miles from the existing delivery points on the railroad to the first of the barracks to be built. The railroad section forces were assembled for the construction of the tracks upon the right-of-way, and a contract was awarded the James McGraw Co., of Philadelphia, for installing the tracks on the government property, but outside the cantonment.

Work on the terminal layout was started June 18 with a small force, which was increased by gradual stages until on July 18 a total force of 350 men and 18 teams was engaged. The men were housed in a camp built by the contractors, and the teams and drivers were taken care of in quarters provided in the vicinity of a near-by farmhouse. Twelve hours was established as the working day, and the work was continued Sundays and legal holidays.

In order to hasten progress in providing a grade for



TRACK LAYOUT HAS LITTLE RESEMBLANCE TO PERMANENT TERMINALS, BUT IS PROVING VERY EFFECTIVE

the tracks, the cuts were first made with vertical sides 5 ft. 4 in. from the center line on tangents and 5 ft. 8 in. on curves. To avoid an irregular cutting on the curves, middle and quarter ordinates from a 100-ft. string were computed, by means of which supplementary stakes were set every 25 ft. This practice further served to facilitate the immediate establishment of correct line on the curves. Care was also taken throughout the grading to leave a smooth and level subgrade, so that traffic could be run on the tracks as soon as laid and before ballasting or surfacing was done.

The dirt was cast up on top of the ground and afterward hauled to the nearest fill. The track over fills was kept to the lowest practical height and then raised to grade as material became available. All cuts were finally widened to 8 ft. from center line for single track and sloped from 2 ft. below top of rail on a 45° inclination. The tracks were ballasted with cinder to a depth of 6 in. below bottom of tie, for which stakes marking the top of rail were placed, and the tracks were then relined to center stakes newly set on the tangents and adjusted by means of ordinates from a 62-ft. string on the curves.

The grading, entirely earth, amounted to 22,000 cu.yd. of cut, which was mainly used in necessary fill. The completed trackage totals 7.5 miles, and 38 switches were installed. The maximum gradient is 1% and all intersections are properly modified by a vertical curve. The sharpest curve, which is that of the loop, is of 435 ft. radius. Since operation over the whole layout is at moderate speed no elevation was applied to any of the curves.

Track Construction

The track construction throughout follows Pennsylvania standards. The main tracks are laid with No. 2 Pennsylvania system 100-lb. rail and are tie-plated on curves and through-switch connections. New ties were generally used, although a limited number of good second-hand ties were interspersed through some of the less important yard tracks. The material supplied for constructing the switches was all new and similarly of the Pennsylvania 100-lb. section. The frogs are, with few exceptions, No. 8, the stiff pattern being used in the main running tracks and the sliding pattern in side tracks. The switches are the newest Pennsylvania standard and are equipped with heel blocks. The guard rails are partly Pennsylvania standard and partly of the Newhall type. New Century switchstands have been used throughout.

The detailed method of constructing the tracks and switches presents several points of interest. The materials for the track layout, exclusive of ballast, amounted to 200 carloads. They arrived at about the same time, and necessarily were unloaded in mass and redistributed. The delivery was made by teams hauling the ties on wagons, dragging the rails by hooks engaging the bolt holes, and either dragging or carrying the frogs, switches and guard rails.

The ties were laid square to the center line with the required spacing and immediately lined on the proper end to a string stretched between offset stakes at the several stations. When the rails were set up and jointed, the line rail was shifted to its approximate final location on the ties. The detailed lining of the ties at the moment of spiking was thus reduced to a minimum, and extensive relining of the track was avoided. Care was taken to follow up the tracklaying closely with a roughing-in of the line before ballast was deposited.

A special method employed in setting up the switch ties gave good results. An ideal bill was designed for the No. 8 turnout, and a gang was selected for collecting, transporting and laying in place on the grade the required ties for each connection. The engineers gave the frog point and the line of the main track. Several switch timbers were laid edgewise along the straight side of the turnout to form a curb to receive the switch ties laid exactly at right angles with it. The position of the several joints was marked on the timber curb and then the location of each tie of the set. The appropriate lengths of the switch ties were written at the points marked. This saved the usual lost motion of shifting the connection into place after being spiked up, and also supplied a convenient guide for the adjacent grading and tracklaying.

As heel blocks were used with the switches, a nice selection of rails was necessary to avoid bad centering or an excess in cutting of rails. A 33-ft. stock rail on one side with a 25-ft. stock rail on the other and a second 25-ft. rail adjoining served this purpose nicely. The lead and turnout rails consisted generally of a 30-ft. rail and pieces respectively 14 ft. 11 in. and 15 ft. 1 in. long cut from a 30-ft. rail. When these were no longer available, pieces 11 ft. 11 in. and 12 ft. 1 in. long were cut from 33-ft. rails for use with a full-length rail in the lead and turnout. The 21-ft. pieces remaining were placed at the heel of the frog and restored the centering for both main track and turnout.

As the switches were all from main track the turnout curve was lined by means of ordinates from a string stretched between heel of switch and toe of frog. The ordinates used were 6 in. at the middle and 4½ in. at the quarters, whether the frog was No. 6, 8 or 10.

The entire work upon the terminal layout was under the direct supervision of the division forces of the Trenton division of the Pennsylvania Railroad.

Measure Snow Density to Forecast Floods

Hydraulic engineers of the Southern California Edison Co., which operates several hydro-electric systems in southern California, believe that unusually heavy flood stages of the streams can be, in large measure, predicted with the aid of snow measurements. It is the custom of this company to send surveying parties over the more important drainage basins of its system as soon as good weather comes in the spring. These parties take measurements of the snow depth at numerous points to obtain an accurate idea of the quantity.

The snow is sampled by means of a brass tube and its density obtained so that proper allowance may be made for wet and dry snow. It has been found that the percentage of water varies from 20 to 75%. With an accurate estimate of the quantity of water lying on the drainage area in the form of snow it becomes a matter of observing weather conditions and applying runoff coëfficients to determine when this water will reach the streams and what its maximum amount might be.

Brooklyn Naval Storehouse Finished Ahead of Schedule

Eleven-Story Concrete Building Frame Completed with Roof in Fourteen Weeks by 500 Men Working One Shift a Day—Monolithic Floor Finished Without Delaying Quick Progress

MOTOR TRUCKS CLIMBED RAMP WITH MATERIALS FOR CONCRETE PLANT

A REINFORCED-CONCRETE storehouse capable of holding 70,000 tons of supplies has been built during the summer in the Brooklyn Navy Yard, and is being completed some four weeks ahead of even the rapid construction schedule required by the Government. Eleven stories high, 180 x 360 ft. in plan, and with monolithic-finish floors, the concrete frame was completed within fourteen weeks after the last piles were driven for the footings. With the 6- to 9-in. floors required by the heavy loads to be imposed, which limited the work as to progress by the hardening of the concrete, the contractor was able to organize a labor force which kept up the best speed possible with one 8-hr. shift a day. This organization, with two 1-yd. mixers and hoists, completed one of the floors in four days and several in five. A pair of 5-ton motor trucks scored an unusual performance in delivering within these fourteen weeks, over a ¾-mile round-trip haul, all of the stone and sand required for the 40,000 yd. of concrete placed.

The first work after the award of the contract for this structure was to drive 3776 concrete piles, which was accomplished in the remarkable time of 30 days, as described on page 62 of *Engineering News-Record* for July 12. No excavation was required, the tops of the piles being at original ground level and a fill of 4 ft. being placed between external retaining walls underneath the first floor. The footings, which extended from the original ground to the first-floor level, were begun on May 21, before piledriving had been finished. All of them had been concreted by June 9, by which time a considerable part of the form work for the second floor had been framed and erected. The actual progress schedule attained for this and the succeeding floors of the building is shown in the table.

The building is designed with rectangular outside and round inside columns. The flat-slab floor system employed has depressed panels at the column heads. The column spacing, 18 ft. center to center in both directions, is uniform throughout the building, giving 60 exterior columns and 171 circular columns. For the latter metal forms were used, all the other forms being made of wood.

Forms for one entire floor and one set of rectangular column forms, requiring in all about 1,000,000 ft. of lumber, were built. The framing of these forms began on May 16, by which time there were about 40 carpenters on the job. The cutting was all done by one saw-mill man, the mill being located at the east end of the building. By the time concreting started on the slab for the second floor, 105 carpenters were on the work, and approximately this number of men were required in handling and reërecting the form work throughout the job. The carpenter force was assisted by an equal or greater force of laborers, about 28 of whom were continuously engaged in carrying forms on the floor being stripped to the hoists, about 26 in stripping, about 40 on the floor above in carrying panels to

ACTUAL PROGRESS OF CONCRETE WORK BY FLOORS

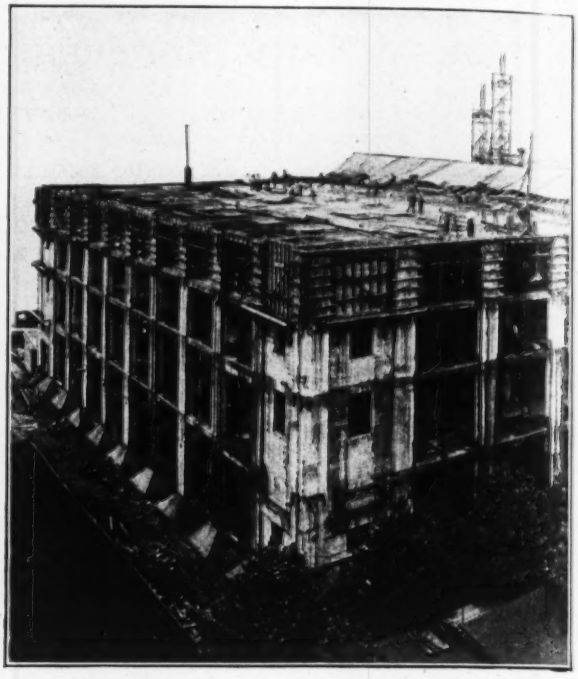
	Started Concreting	Finished Concreting
Footings	May 21	June 9
Second floor	June 12	June 20
Third floor	June 21	June 28
Fourth floor	June 29	July 7
Fifth floor	July 9	July 14
Sixth floor	July 16	July 20
Seventh floor	July 21	July 26
Eighth floor *	July 27	Aug. 4
Ninth floor †	Aug. 6	Aug. 15
Tenth floor	Aug. 17	Aug. 22
Eleventh floor	Aug. 23	Aug. 30
Roof	Aug. 31	Sept. 12

* Hot weather. † Strike.

place, and about 14 carrying and placing wood column and wall forms. In addition to this force, one foreman and 18 sheet metal workers were engaged continuously in stripping, moving and reërecting the interior column forms.

The floor forms were planned so as to secure uniform interchangeable panels for all of the flooring except the depressed panels at the column heads. These were made in halves. One of the drawings shows this arrangement, which simplified erection and gave panels of convenient size for handling by four men. Because the building was on Government property, and with open space on all four sides, it was permissible to hoist the forms outside of the structure, which made it unnecessary to leave out sections of the floor above or carry the forms long distances to stair wells or elevator shafts to hoist them. The hoisting apparatus, shown in the photographs, consisted of small gin poles on which winches were mounted. By using five or six of these it was possible to reduce the distance the forms had to be carried.

All the reinforcing, cement and other material received by rail was brought to the Navy Yard reservation on car ferries, and the cars switched to the job over the Navy Yard tracks. The sand and stone for concrete and the grit for floor finish was received in scows, unloaded by a clamshell derrick within the limits of the Navy Yard about ¾ of a mile from the building, and dumped into a portable wood hopper, from which motor trucks could be loaded. On the north side of the building, where the concrete plant was located, the material bins were erected with a ramp leading up to gratings over them on a 10% grade, and down on the other side with a 15% grade. It was thought that the two trucks would do well to carry their rated capacity of 6 tons up to 10% grade, but both the trucks, which



FIRST FLOOR ON FILL AT TOPS OF COLUMN BASES

are Pierce-Arrows, have several times hauled 5 yd. of material up the 15% grade. The trucks are dumped through the gratings over the bins. They worked eight hours a day, and averaged 600 yd. in that time, while the concrete plant was running.

The 300-yd. stone bin was on the south side of the structure nearest the mixers, with the 150-yd. sand bin next and the 100-yd. grit bin farthest from the concrete plant. Underneath these bins, filled by hopper gates, ran measuring cars on two tracks, one for each of two 1-yd. Ransome mixers. On both sides of the charging platform in which these tracks were set was storage space for 16 cars of cement. This quantity of cement was kept on hand most of the time, the mixers being supplied directly from the box cars, which could be switched directly alongside the north edge of the charging platform. By excavating six feet for the concrete mixers, the level of the charging platform was brought slightly below the car floor so that the cement could be handled on gravity rollers.

Both the mixers and the two hoists were belt driven, a 65-hp. motor being connected to each unit. The size of the pulleys was so adjusted that the rope speed of each hoist was 170 ft. per minute, and each mixer made 16 r.p.m. At these speeds the capacity of the mo-

HEAVILY BUILT WAREHOUSE HOLDS SEVENTY THOUSAND TONS OF SUPPLIES

was sufficient to prevent an undesirable change of speed when the hoist was thrown in or out. The hoists used were ordinary one-drum skeletons with a pulley wheel set on the drive shaft. The long drive shaft and pulley were put on the hoist and the entire rig set up at the job by the contractors.

In addition to the concrete hoists, two brick hoists were erected, as shown in one of the photographs, for handling hollow tile used around the elevator shafts and stairwells. On these towers were erected booms for hoisting the reinforcing.

The operation of the mixer plant required 18 laborers and 2 engineers. As the car tracks on the charging platform were given a pitch of 1½ in. in 40 ft. toward the mixers, it was possible for two men to fill, handle and dump each car. One laborer was required to discharge each mixer into the tower skip, another on the water at each mixer, two handling cement for each plant, one handling sacks at each, and two more transporting cement from the cars to each hopper. During the work each mixer averaged 45 yd. an hour while in service, so that the plant mixed and hoisted, on the few occasions when both machines were kept busy a full 9-hour day on concreting, more than 700 yd. As a rule, however, after 3000 or 4000 sq.ft. of floor had been concreted, one of the mixers would be taken off concrete and used to mix floor finish. With this much start one mixer could concrete as much slab in the remainder of the day as the second mixer could supply mortar for finishing. The ¾-in. finish put on required about 150 yd. of mortar for each floor, using one part of grit, one of sand, and one of cement. The entire concrete plant, as usually operated in this way, averaged 1000 bbl. of cement a day.

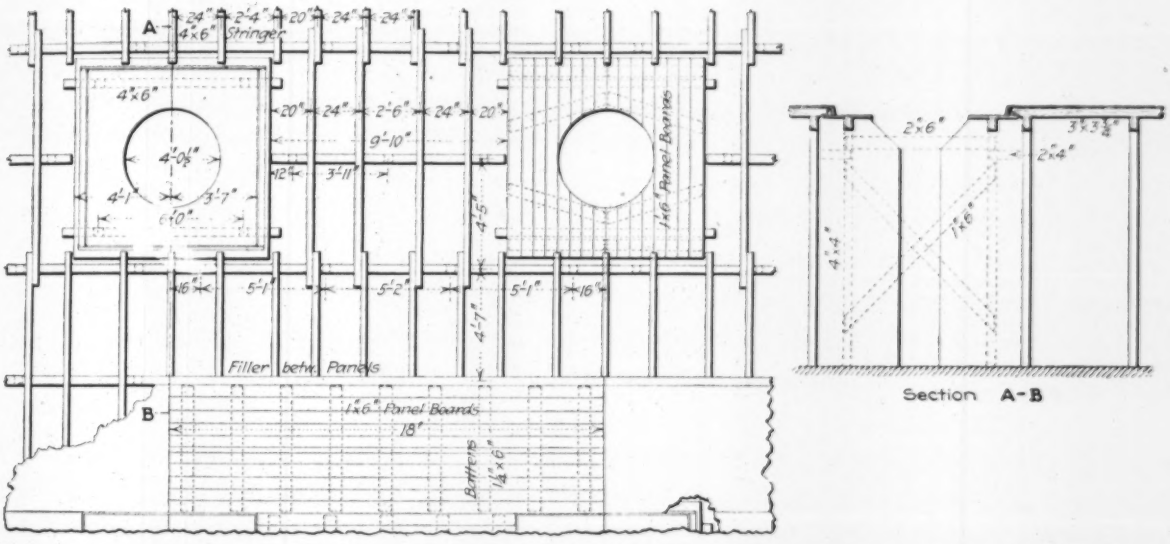
The concrete was dumped by the hoists into hoppers at the floor on which work was in progress. From here it was drawn into buggies and wheeled to place. A total crew of 54 laborers on the floor was required on this work, 4 of whom were at the gates loading the buggies, a maximum of 28 of whom were wheeling, 16 engaged in placing the concrete, and 6 in handling the runways.

The penthouse and skylight structures on the roof were concreted from elevated runways built on trestle work after the roof slab itself had been completed.

About 13,000 sq.ft. of floor finish was deposited in a day by this same labor organization, following up the concrete work. Some 20 cement finishers were required to take care of this amount of work.

The reinforcing was unloaded to stock piles and handled from the piles to the point of use on the floor by a gang of 17 laborers assisting the lathers, who bent and placed the steel. Twenty-six of the latter were employed throughout the work. The reinforcing for the columns was made up and lowered into the forms in full-height units, while the slab reinforcing was supported on cement blocks resting on the form work.

Dirt was brought by the contractor from cellar and other excavation work under way in Brooklyn for the fill under the first floor. This fill, which amounted to 7500 yd., was completed in time for the ground floor to be finished while the roof was being concreted.



ONLY DROP PANELS ALTERED AS COLUMN SIZE DECREASED—OTHERS WERE INTERCHANGEABLE

The curtain walls, tile partitions, stairs, steel sash, elevator installation and trim were all begun after the 4th floor was concreted and carried up as the work progressed. It was contemplated in the contract that the Government could occupy one-half of the building on Oct. 23, practically all of the remainder on Nov. 18, and that the entire structure would be turned over by Dec. 9. All of these dates could be advanced at least three weeks, owing to the rapid progress made.

	Concrete	Reinforcing	Column Forms	Finishing	Wood Forms	Miscellaneous	Total
Office force and foremen							23
Carpenters					107		107
Sheet metal workers			18				18
Lathers		26					26
Masons				20		6	26
Laborers	72	17			108	153	350
Total							550

A recapitulation of the way in which the labor force in the different trades employed on the work were divided between the principal classes of work required is shown in one of the tables.

The work has been carried out under the direction of

the Bureau of Yards and Docks of the Navy Department, Admiral F. R. Harris, U. S. N., chief of bureau; Civil Engineer Kirby Smith, U. S. N. in charge of storage depots; Civil Engineers L. M. Cox, U. S. N. and W. A. Allen, U. S. N. in charge at New York Navy Yard. The general contract was carried out by the Turner Construction Co., for which the Raymond Concrete Pile Co. drove the foundation piles. For the Turner Co. the work has been in charge of R. C. Wilson as engineer and W. T. Anderson as superintendent.

Wayne County Board Reports on Concrete Road Work

Two-Course Construction Still Practiced Because of Scarcity of Good Pebble Aggregate—Road Shoulders Macadamized

ALTHOUGH its preference is for the one-course type of concrete road construction, the Board of County Commissioners of Wayne County, Michigan, this year built all of its concrete highways in two courses. Scarcity of good quality pebble aggregate for the wearing surface, the chief cause for the adoption of the two-course method last year, as noted in *Engineering Record* of Dec. 9, 1916, p. 705, was the reason for the continuation of this form of construction from Oct. 1, 1916, to Sept. 30, 1917, the period covered by the Board's latest annual report, from which the following excerpts are taken:

Reasons for Two-Course Construction

Our past experience, says the board, has taught us that it is desirable that the aggregates in the wearing surface of our roads should be of a uniform quality, clean, hard, tough and well graded. We have had so much difficulty in getting a sufficient quantity of pebbles that met our requirements that we have changed our specifications from one-course to two-course construction, using Wisconsin granite or trap rock for our wearing course, and washed pebbles or crushed limestone for the lower course. Other things being equal, our preference is for one-course construction, as the two-course work is more expensive in the labor item and in the cost of the coarse aggregates used for the wearing surface. However, we believe that through the uniformity of the quality of the trap and granite, we are justified in making the additional expenditure predicated on our roads lasting for a much longer time.

A material change has been made in our specifications by increasing the width of our expansion joints from ¼ to ½ in. We have found in several instances that roads six and seven years old have buckled at the joints and several slabs have slipped over the top of the adjoining sections. We have made the change as a precaution against future occurrences of this character. From year to year, we are giving more attention to little experiments and care of details. More attention is being given to rigid inspection of aggregates, consistency, mixing, finishing, curing, preparing of subgrade, alignment, laying out and widening curves, all of which add to the cost of our work but more important still, add to the quality, appearance, safety and life. We are also continually improving our maintenance methods, which we believe to also be the part of wisdom.

Labor this summer has been scarce, high-priced, and unreliable, necessitating frequent reorganization of crews. In order to maintain an average working force of 400 men we have hired upward of 1200 men during the past season. We have been compelled to take shipments of pebbles, crushed stone and sand in box cars, making useless our clamshell unloading devices and creating a further shortage of labor to do the work machines can do quicker and cheaper. In addition to labor and car shortage, materials naturally have been hard to secure in quantities that would keep our work going smoothly, and as a consequence thereof we have been unable to complete the work planned and laid out.

Road Maintenance

With the tremendous increase of traffic in Wayne County, the shoulders on our various roads are being used to a greater and greater extent, because the road metal is too narrow. We have had two maintenance crews in the field all season doing practically nothing else but macadamizing or graveling the shoulders in order to relieve traffic congestion. While this might well be termed a "road betterment," we have charged it against maintenance. We expect to continue this work until all of the mileage previously built will have first-class macadam shoulders. On several highways it was found desirable to oil the shoulders to make them dustless. We are now building no concrete road of a lesser width than 18 ft. It has also been necessary to resurface and oil practically all of our gravel mileage, which work is still under way.

We have repaired such defects as have developed in the metal of our concrete road mileage, consisting of cracks and an occasional hole. This problem, however, is a simple and inexpensive one. Equipped with a tar-kettle, several wire bristle-brooms, a wheelbarrow, a couple of shovels, a tar-bucket, and sprinkling cans, a team and a small crew of men are an adequate force for doing this work. Cracks and spalled joints are swept clean with the wire brooms, after which tar, heated to 225 deg. F., is poured into the clean crack and allowed to stand for a few moments to prevent it from bubbling. Clean, coarse, dry sand is then spread on the tar from a shovel. Any pit holes are given the same kind of a treatment. A slight excess of tar and sand is used, so that traffic will eventually iron out the application. Practically all communities having concrete roads have followed the methods of maintenance which we have developed. A grade of tar, known under the trade name of Tarvia XC, is used.

If an imperfection that does not extend through the pavement, yet is over an inch deep, is to be treated, the cavity is thoroughly cleaned out. It is then dried, painted with hot tar, and filled with stone of suitable size so graded that the bulk of the stone will have voids reduced to the lowest possible point. This filling is then firmly tamped or rolled into place. On top of this patch, hot tar is poured, the quantity being so regulated that it will be enough to fill in voids remaining in the pebbles or stone and leave but a slight excess on the surface. Dry sand is then spread on this excess and traffic irons it down as in the case of similar repairs to joints.

One maintenance crew will do all necessary work on from 1 to 3½ miles of concrete road surface in a day. Where we have occasion to repair holes that are two or more inches deep, we clean them out thoroughly, cutting away the concrete so as to give truly vertical sides to the hole, paint the edges with a cement grout, and fill the cavity with a concrete mixture proportioned as was that used in the original construction. The repaired portion is protected from traffic until thoroughly hardened, and hardening is accomplished by keeping the repaired spot covered with a moist layer of earth, kept moist by frequent sprinklings for at least seven days.

In addition to the foregoing, weeds are kept cut; the ditches and drainage structures cleaned out both spring and fall to afford a free flow of water; guard rails and bridges, painted and repaired; and all other necessary items are taken care of to keep our highways up to their highest point of efficiency, prolong their usefulness and make them safe and sightly. We have continued to drag our roads during the winter months to keep the snow leveled down, thus making them safer for travel and distributing the wear over a greater area of roadway.

The total expenditures for this work are as follows:

Tarring and repairing cracks and holes on 150 miles of concrete road	$5,475 76
Tarring and repairing 2 miles of macadam road	831 11
Brick mileage (1¼ miles)	302 14
Resurfacing, oiling, dragging, cutting weeds, cleaning ditches, on 20 miles of gravel road	20,040 07
Macadamizing shoulders, cutting weeds, cleaning ditches, on 2 miles of macadam road	1,340 27
Macadamizing and oiling shoulders, cutting weeds, cleaning ditches, on 150 miles of concrete road	25,354 80
	$53,344 15

Another East River Bridge Suggested

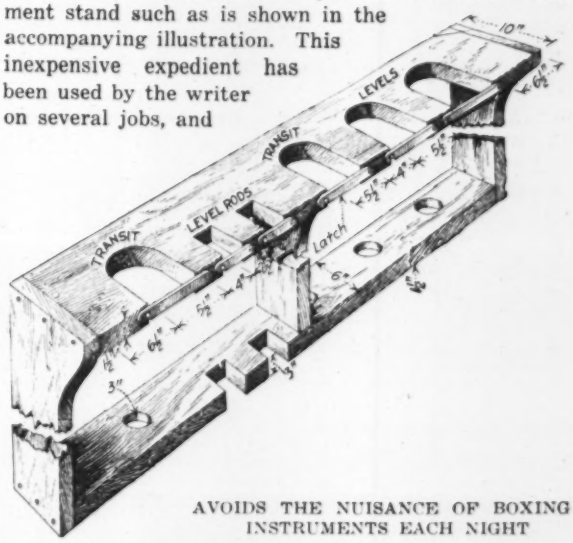
ANOTHER very large bridge structure across the East River in New York City has been projected by one of the city departments and is announced in the report of the Department of Plant and Structures of the City of New York for the year 1916, just issued. The new bridge, for which studies were made by the engineers of the department but which has not yet officially been brought to the attention of the Board of Estimate and Apportionment for the purpose of having money appropriated, is a tri-borough bridge connecting the Boroughs of Queens, Manhattan and the Bronx, and is located just alongside of the Hell Gate arch recently opened to connect Long Island City with the Bronx. The plan provides for a bridge structure approximately 15,000 ft. in length, the Queens terminal of which would be at Second and Potter Aves., the Manhattan terminal at First Ave. and 125th St., and the Bronx terminal at St. Ann's Ave. and Southern Boulevard. The structure is planned to cross Hell Gate channel, Ward's Island, Little Hell Gate channel, to Randall's Island, and then to divide into two branches, one of which crosses the Harlem River to Manhattan, and the other the Bronx River to Southern Boulevard. Provision would be made for vehicular, pedestrian, surface railway and rapid transit railway travel.

At the Hell Gate channel the bridge would be carried by a large cantilever steel span, and for the approaches in Queens and on Ward's and Randall's Island, including the crossing at Little Hell Gate, reinforced-concrete would be used. The Manhattan connection, extending from Randall's Island to First Ave., would be similar in design to the present drawbridges over the Harlem River, with the exception that the opening for navigation purposes would be made by a lift span instead of a swinging span. Inclined approaches are provided for Randall's and Ward's Island for vehicular and pedestrian travel, thereby affording for the first time vehicular communication with those islands from the mainland. The bridge is thought to be necessary in the near future as a means of communication from the upper part of Manhattan to Long Island for motor and motor-truck travel, and as a proper connection in the extension of rapid-transit lines from the Astoria terminal to the Borough of the Bronx, providing a means of communication between Brooklyn and the Bronx, without passing through the Borough of Manhattan. The estimated cost of the entire structure at normal prices for materials and labor would be about $10,500,000.

Stand Eliminates Necessity of Boxing Instruments Every Night

BY GEORGE W. MCALPIN
Junior Engineer, U. S. Engineer Field Office, Maysville, Ky.

ALL THE TROUBLE and waste of time in removing surveying instruments from their tripods and placing them in their boxes at the end of the day's work can be avoided if an office is provided with an instrument stand such as is shown in the accompanying illustration. This inexpensive expedient has been used by the writer on several jobs, and



AVOIDS THE NUISANCE OF BOXING INSTRUMENTS EACH NIGHT

has been found satisfactory in every case. The construction is very simple. Slots cut into a 1½ x 10-in. plank provide recesses into which the tripods and levels may be set. The tripods are then held in the slots by metal latches hinged at one side and fitting over a nail at the other. The feet of tripods and the lower ends of level rods fit into holes cut in another plank set lower.

Equalizing Bids for Brick and Concrete Sewers

TO GET truly competitive bids when inviting proposals for sewers of different materials on the same streets a city in the Central West took the friction factor into account. Thus, brick sewers were specified to be larger than concrete sewers, the difference in diameter generally being three inches.

Screens, Filters and Humus Tanks for Indianapolis

Imhoff Tanks and Sprinkling Filters, and Activated-Sludge Process Eliminated—Non-Putrescible Effluent for River Will Cost $3,000,000

AFTER the three latest methods of disposing of sewage had received close consideration, a combination of fine screens, deep filters and sludge recovery in humus tanks has been recommended to the Board of Sanitary Commisioners as the best system for Indianapolis to adopt. George W. Fuller, consulting engineer, made the report. From it the following notes are taken. Other sewage treatment projects considered were Imhoff tanks followed by sprinkling filters, and the activated-sludge method.

The flow of White River, into which the raw sewage now discharges, is insufficient for five months of an ordinary year during the warmer season to prevent objectionable putrefactive conditions. The treatment must therefore, be complete enough to produce a non-putrescible liquid with substantially no river water to dilute it.

The characteristics of this sewage are its freshness at virtually all times, and the relatively large proportion of suspended matters which comes from trade wastes. These trade wastes are found upon studying the individual analyses, made in 1912 and for a year when the testing station was operated, ending March, 1915, to show marked variations at different seasons of the year, and of course, the same is true at different hours of the day, on account of the irregular manner and rate of releasing the wastes at their point of origin.

A personal inspection of the principal industrial establishments was made, and with the understanding that the gas-works will treat their waste products on their own grounds, no material evidence was found that the trade wastes will interfere with ordinary sewage-treatment processes. A large proportion of the suspended matter of the trade wastes comes from packing establishments and canning factories. These facts are of importance in noting the relatively high proportion of organic nitrogen in the local sewage, the analyses of which show that of the total suspended matters about 3% is suspended organic nitrogen, obtained by the Kjeldahl method.

Three Methods Considered

The three methods of sewage disposal which Mr. Fuller considered are as follows:

1. Sedimentation in Imhoff tanks with the sludge put on drying beds so as to allow it to be used by farmers in the vicinity, or for filling low land, and with the settled sewage oxidized to a non-putrescible state in sprinkling filters and settled in humus tanks, frequently spoken of as final settling tanks.

2. Aëration of the sewage in contact with activated sludge, followed by sedimentation, and with the deposited sludge filter pressed and dried in rotary dryers.

3. Fine screens to remove the coarser suspended solids, with the screened sewage applied to deep sprinkling filters for purposes of oxidation, and with the effluent thereof put through humus tanks, the sludge from which will be filter-pressed and dried for sale to the fertilizer trade.

Project 3 represents in a measure a combination of the objects sought by 1 and 2 and is based upon long continued investigations at the testing station of the Massachusetts Institute of Technology and at Worcester, Mass. it is the method which has been recommended by Mr. Fuller for the treatment of the sewage of the southerly part of Cleveland. The sprinkling filter of Project 3 is comparable with that in Project 1, except that the beds would be deeper, with a view to retaining as much soluble organic matter as practicable in order to increase the fertilizing value of the sludge of the humus tanks, in which respect Project 3 resembles Project 2. The purpose of the substitution of fine screens rather than Imhoff tanks is partly to increase the amount of sludge recovered for fertilizer purposes, partly in the interests of economy as to total cost, and partly with the view to reducing odors in the general neighborhood.

In 1914-1915 Indianapolis tried experimentally and successfully the methods outlined in Project 1.

Odor Nuisance Determinative

The reason for considering the other two methods was to inquire into the economic aspects of other means of bringing about equal purification and at the same time lessening the likelihood of odors at a large treatment plant for a growing city at a site now reasonably isolated, but which may not be so isolated in coming years.

With sewage as fresh as will be delivered to the Indianapolis plant, it is not likely that odors will be noticeable more than about 500 ft. distant when the plant is working normally. Imhoff tanks, however, sometimes behave very abnormally and produce seriously objectionable odors, particularly during the first year or two of their operation. These are caused either by the withdrawal of incompletely septicized sludge or by the putrefaction of gas-lifted sludge in the gas vents. Substantially complete protection against odor troubles from Imhoff tanks can be obtained under local conditions by the installation of fine screens in advance of the tanks and by providing spare units of sludge digestion chambers or both.

Some of the more pertinent statements with reference to Project 3 are as follows: Fine screens remove on an average about 10% of the total suspended matters in fresh municipal sewage, and more than this where the sewage contains trade wastes with suspended matter of relatively large size. The screenings, containing about 80% of water, would amount at Indianapolis to more than 8000 tons per year. They can be best disposed of by burning with coal in small incinerators.

A removal of 10% of suspended matters by screens should adequately protect sprinkler nozzles. It is a fact, however, that screens will not remove as much either of organic or of suspended matter as will Imhoff tanks, but the recovery of solid matters after filtration

makes it desirable not to remove a needless amount of suspended matter prior to filtration and then destroy a part of its organic nitrogen through septicization processes.

Unquestionably, it is necessary with screened sewage to use a greater volume of filtering stone per unit volume of sewage in order to bring about an adequate and equivalent degree of purification, as compared with that which would be effected with sewage clarified in an Imhoff tank, other things being equal. This phase of filter loading has been taken care of by assuming that with an Imhoff tank effluent the filters would be 7 ft. in depth and with screened sewage the depth would be 10 ft., the area of filter surface being the same in the two instances.

Removing Suspended Solids

In a process in which the solid matters, settling out from the effluent of sprinkling filters, must be dried for use as a fertilizer, obviously it becomes necessary to resort to procedures which will make as uniform as practicable the removal of suspended solids from the sprinkling filters. This means that it is necessary to lessen the heavy unloading which occurs normally in the spring, with much more suspended matter in the effluent than in the influent of the filters, and to adopt a systematic procedure for distributing this unloading throughout the entire year. This is manifestly necessary in order to keep within reasonable limits the capacity of the plant for pressing and drying the sludge and to keep the operating staff provided with a fairly regular working schedule.

When sprinkling filters are put out of service there is a drying action which causes much of the suspended matter in the upper portions of the bed to dry, crack, peel and pass out with the effluent. It is proposed with these deep beds to resort to this drying action at intervals and then to flush the beds with filtered sewage applied with a hose under pressure. This has been found in England and at Philadelphia to be an effective means of dislodging suspended matters.

From the sprinkling filter the treated sewage will flow through humus tanks of the vertical or Dortmund type having an average detention period of 2.4 hours. The settled sludge will be removed from these tanks with a water content of about 93%, which by resettling in concentrating tanks will be reduced to about 87%. This resettled sludge will then be reduced to a water content of about 75% in filter presses, and dried in rotary driers to about 10%, as required by the fertilizer trade.

The wet sludge removed from humus tanks will average 8 to 9 cu.yd. per million gal., and this will be dried to about 0.7 tons of finished fertilizer product per million gal., containing about 3.5% ammonia, worth at the present time about $7 per ton.

Pressing and Drying Operations

As to the pressing and drying operations, these can be made virtually non-odorous if care is taken to build amply large scrubbing chambers through which to pass the gases from the driers, and then to pass these gases through an ignition chamber maintained at a high enough temperature, by the aid of oil or gas, to destroy the remaining odoriferous products.

Comparing the advantages and disadvantages of Project 1, and in particular upon comparison of this project with other available projects, it is concluded that this method, which a few years ago was almost universally adopted for large inland cities, would give generally satisfactory results, if installed at Indianapolis. It is subject, however, to legitimate criticism along the lines of needless odor production and on the grounds of needless total expense, when consideration is given both to the investment cost and to net operating charges.

On the score of objectionable odors the local situation is such that it is important to take every reasonable step to minimize objectionable odors and to adopt a treatment method which is least likely to show periods of abnormal behavior when the manageability of the plant as to control of odors may become unreliable. The available evidence indicates that if fine screens in advance of the Imhoff tanks and reserve digestion chambers are provided, the control of odors could be made reasonably satisfactory. However, this would add materially to the cost of Project 1 and with no income as to fertilizer product, it would substantially bar this method on the ground of cost.

Of the three methods under consideration, the activated-sludge process is the cheapest one to install at Indianapolis and will produce the most complete purification. By giving liberal credit to the activated-sludge process for the proceeds from the sale of a sludge of a high nitrogenous content to the fertilizer trade, the total annual cost (capital charges and net operating expenses) of this project approximates that of Project 3, but still remains cheaper than that of Project 1, particularly if the latter were to be provided with fine screens and spare digestion chambers for placing all three projects on a parity as to freedom from odors.

Project 3 Preferred to Project 1

Taking everything into account, it is concluded that under local conditions the activated-sludge process is a less desirable one to install than Project 3. This is based on the variable composition of the Indianapolis sewage, on account of variations in quantity and quality of trade wastes, and on the lessened certainty in obtaining proceeds from fertilizer sales as estimated for the activated-sludge process, compared with corresponding proceeds allowed for Project 3.

In comparing the status of the activated-sludge process at Indianapolis with its suitability elsewhere, recognition should be given to the fact that there is no opportunity locally to effect any saving in the purchase of land, or in the construction of intercepting or outfall sewers by locating this compact type of plant nearer the city than would be feasible with a sprinkling-filter layout.

Project 3 has a decided advantage over Project 1, both in point of freedom from odor and in net cost of operation. The investment cost is substantially the same for the two projects and is decidedly in favor of Project 3 if Project 1 were to be equipped with fine screens and separate digestion chambers so as to give equal service as to freedom from odors. Comparing Project 3 with Project 2, the investment cost is somewhat in favor of the latter, although the total annual cost, all things considered, is in favor of Project 3.

It is estimated that this project will cost $3,090,000 for construction, and that the net annual operating expenses, after making due allowance for the proceeds of the sale of fertilizer products, will be about $42,370. As this investment cost is in excess of the available funds at the disposal of the commission, Mr. Fuller recommended the adoption of Project 3A, which is identical with Project 3 as to intercepting sewer, pumping station and screening plant, but which contemplates only about two-thirds of the full installation for sprinkling filters, humus tanks, and sludge-handling arrangements. It is estimated to cost $2,438,000 for construction, with net annual operating expenses of $50,370. This procedure will allow of fine screening all the sewage continuously and the full treatment during short periods of drought of even more than two-thirds of the sewage of the city, and would be a long step toward eliminating nuisances on the river below the city.

The sewage disposal problem of Indianapolis is in the hands of three engineers, B. J. T. Jeup, Charles H. Hurd and Jay A. Craven, who comprise the Board of Sanitary Commissioners.

The commission has decided to study further Projects 1 and 3, especially with reference to the feasibility and expense of pressing and drying the sludge for fertilizer on a large scale, the available markets and the reliability of mechanically operated screens.

The estimates made by Mr. Fuller were based on the prevailing high prices. Since the report has been received prices have dropped somewhat, and the commission is of the opinion that it can build the entire plant under Project 1 or 2 within the available funds, especially since a large gravel bed underlies the site for the plant and will provide aggregate for the concrete of which most of the structures will be built.

Laurentide Power Developed After War's Interruption

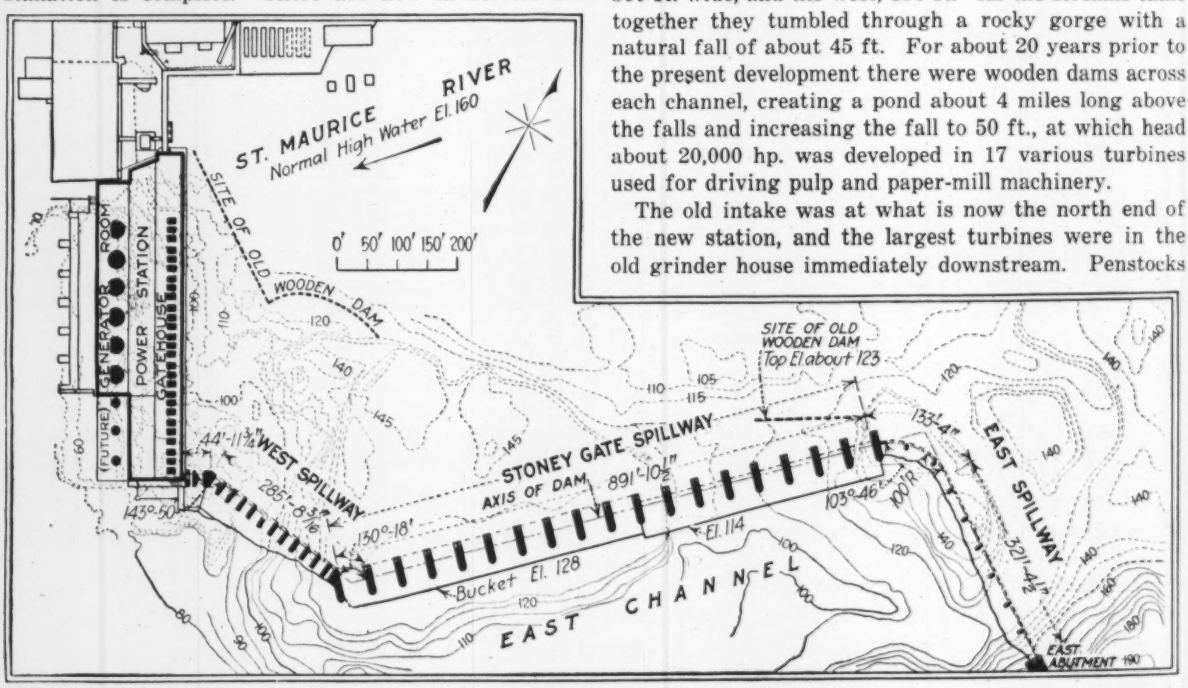
Capacity of Plant Increased by Raising Head to 84 Feet—Substructure Reinforced by Mass Additions—Series of Open and Gated Spillways Will Pass Floods of 200,000 Second-Feet

THE GREAT hydro-electric station of the Laurentide Co., at Grand' Mère, Quebec, is notable for the attention paid to finish on both outside and inside. Some interesting features of the development here are due to a change in the hydraulic conditions made after the work was well under way. The present development shows a record figure of masonry placed per horsepower of capacity created for medium-head plants of this type—having concrete penstocks molded in the substructure. The cost per horsepower of turbines installed, including riparian rights, is notably low (under $50) and will be reduced to less than $40 when the projected installation is complete. There are now in service six (out of nine eventually) 25,000-hp. single-runner units that were the highest in capacity when set and have since been exceeded only by the higher-head machines at Yadkin Narrows, North Carolina.

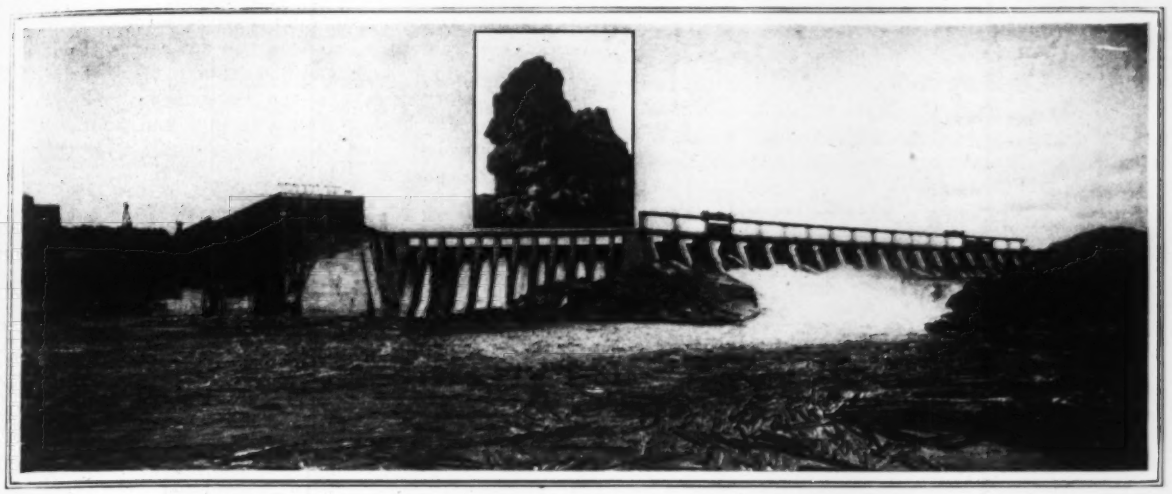
Work on the Laurentide development was started early in 1913, but was shut down in October, 1914, owing to the war. However, the demands for power in the province grew rapidly and the initial construction was resumed in May, 1915, and completed by the beginning of 1917.

The St. Maurice River at Grand' Mère was split by a large rock island into two streams—the east channel, 300 ft. wide, and the west, 350 ft. As the streams came together they tumbled through a rocky gorge with a natural fall of about 45 ft. For about 20 years prior to the present development there were wooden dams across each channel, creating a pond about 4 miles long above the falls and increasing the fall to 50 ft., at which head about 20,000 hp. was developed in 17 various turbines used for driving pulp and paper-mill machinery.

The old intake was at what is now the north end of the new station, and the largest turbines were in the old grinder house immediately downstream. Penstocks



POWER HOUSE AND THREE SECTIONS OF SPILLWAY FORM A 2230-FOOT DAM



A LONG CREST-GATED DAM STRETCHES ACROSS WHERE GRAND' MÈRE PINNACLE STOOD

ran out to the other scattered units. The old intake had to be left in service until two units of the new station were running and electric drives substituted for the old direct-connected mill turbines. This was done by extending the grinder house northward and shifting a unit at a time, without decreasing the production output of the mills. When the shift was completed the old intake was closed by a retaining wall mentioned later.

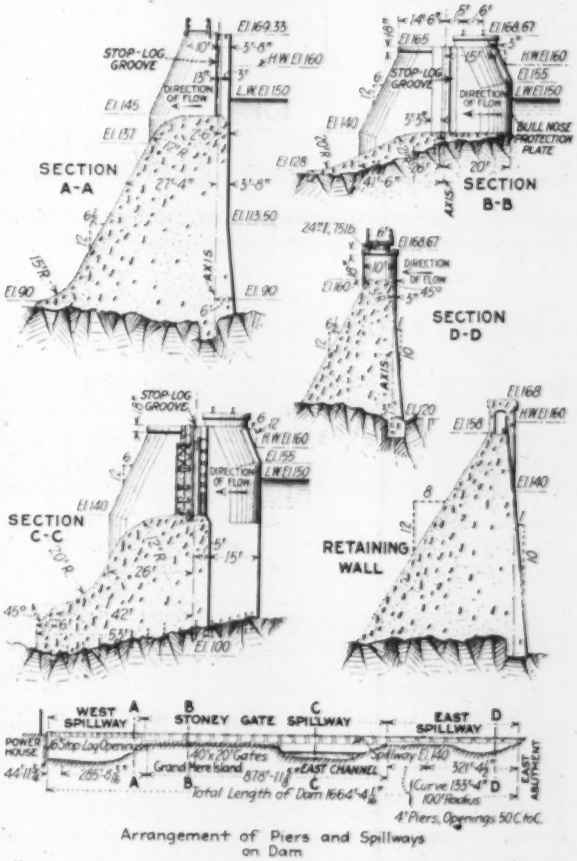
Concrete Dams Replace Wood

For the new development a series of concrete dams has been thrown across the river, downstream from the old wooden dams. The power house itself forms the dam across the west channel except for a stretch of 330 ft. to what was Grand' Mère Island (now removed). This west spillway consists of a gravity overfall section with 14 piers, mostly 16 ft. apart, supporting a footbridge. Stoplogs will ordinarily be kept between piers on this section of spillway (for the present to El. 156 and eventually to El. 160) when the pulpwood storage yard has been filled in to its ultimate level.

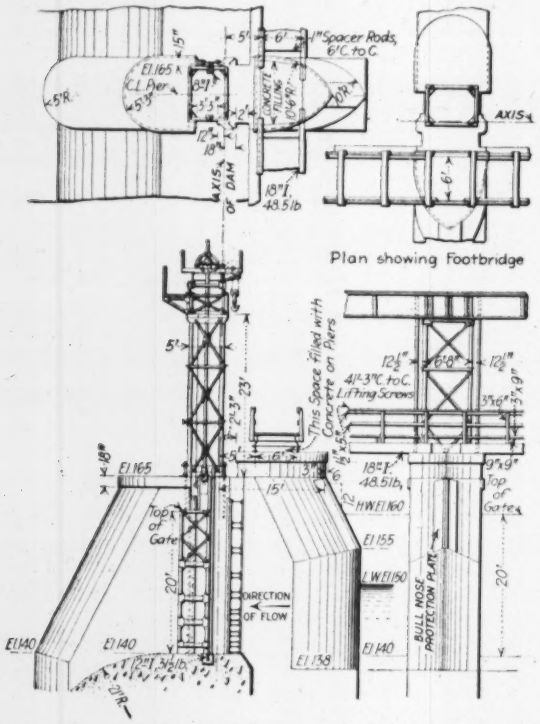
Over the old island, which has been excavated down to El. 144 upstream of the dam so as to give a good approach for high water, and across the east channel the main spillway extends for about 890 ft. It consists of a low gravity overfall section (crest at El. 140, normal water level, El. 160) with 18 gates. Piers, 46 ft. long by 25 ft. high, support the gate frames and footbridge. Beyond the east end of the main spillway is a wing wall, having its crest at El. 160, springing off at an angle and tying into the high east bank.

From the north end of the power house a solid gravity-section cut-off wall on rock runs around the mill's water-supply settling basin and barker room to protect the buildings below the dam. The top of this wall is at El. 138 and the entire development has been planned so that no possible danger can be done with water up to El. 168. With the water at El. 160 and all the spillway gates raised the dam will pass 200,000 sec.-ft. (approx. 12½ sec.-ft. per square mile of drainage area) or 20% more than the maximum recorded flow. At the end of the station there are three sluiceways, together capable of passing about 5000 sec.-ft. One of these sluices has lowering gates to facilitate skimming off trash without wasting water.

The design of the main spillway gates is seen from the drawing. They are of the regular Stoney type, handled from steel bridges. The gate slots are fitted with end and back bearing channels and front sealing angles. Round bronze sealing rods are hung somewhat loosely in the upstream corner between gate and sealing angle as detailed on p. 976.



TYPICAL SECTIONS OF LAURENTIDE DAM



THE 40 x 20-FOOT STONEY GATES ARE HANDLED FROM A BRIDGE BY A TRAVELING HOIST

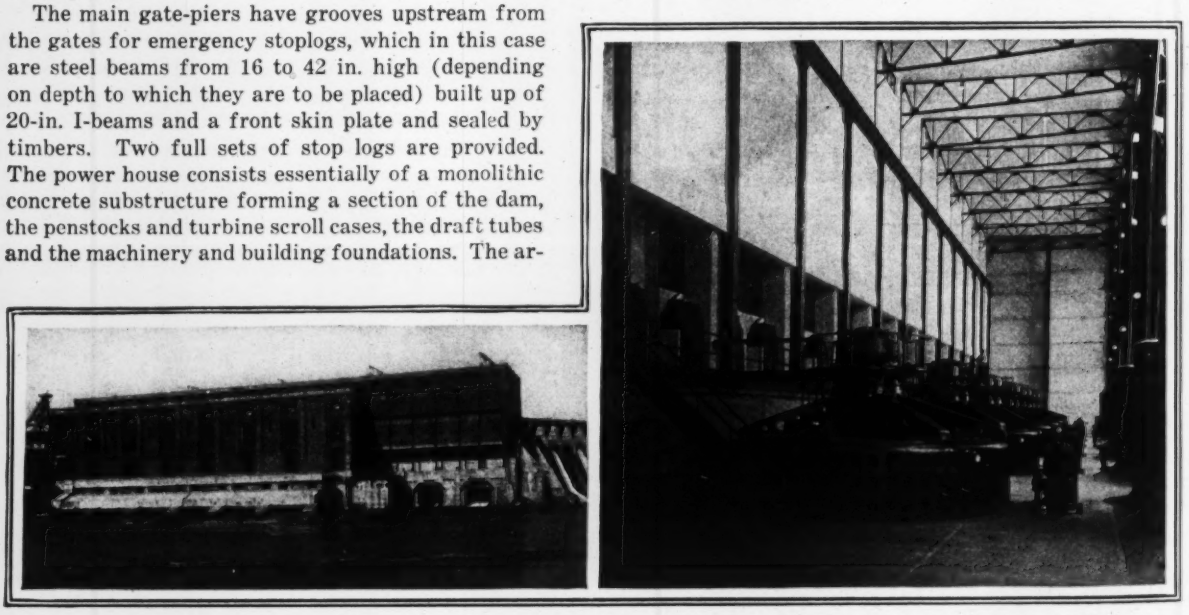
The tops of all the gate bridges are connected by a trolley track of 3-ft. gage, on which the gate hoist is run from place to place. The hoist screws are let down to engage the eyes at each top corner of the gate. After the gates are up they are supported on their own bridges by pins (thrown in by the center lever shown in the accompanying sketch) so that the trolley can disengage and go along. Lowering is of course a reverse process.

The main gate-piers have grooves upstream from the gates for emergency stoplogs, which in this case are steel beams from 16 to 42 in. high (depending on depth to which they are to be placed) built up of 20-in. I-beams and a front skin plate and sealed by timbers. Two full sets of stop logs are provided. The power house consists essentially of a monolithic concrete substructure forming a section of the dam, the penstocks and turbine scroll cases, the draft tubes and the machinery and building foundations. The arrangement is shown in plan and elevation. This results in a generator room on the downstream side 87 ft. high by 45 ft. wide and 325 ft. long (for six units). Back of this room are the low-tension (6600-volt) switching and busbar compartments and above these the transformer room 25 x 25 x 400 ft. Over this in turn is the space 33 x 40 x 400 ft. for the high-tension buses (100,000 volts).

At the north end are the control departments. On the transformer level are control switches and transformers for the mill grinder motors, lubricating and switch oil storage. On the half story above are the storage batteries, the motor-generator sets for 220-volt control circuits, cranes and auxiliary excitation. On the high-tension level are the wash rooms and offices. On the half story above is the control apparatus and bench-board panels, including the switchboard controlling the grinder motors.

On the same level, and of about the same size as the high-tension room, is the gate room. It is separated from the former by the thick top section of the concrete substructure, which, however, is pierced by doors and heating-flues. In the gate room are gratings over the racks in each inlet passage and, upstream from these the emergency gates—plated steel frames in three sections handled by a 20-ton traveling crane. The main gates are placed along the inside wall of the gate room and each is raised or lowered by its own hoist or by the gate-room crane in emergencies.

Underneath the outer wall of the gate room a curtain wall spans between piers and hangs down to El. 147. The warm air from under the roof of the generator and high-tension room is drawn down by a motor-driven fan for each unit and forced into the rack chamber. This is to preserve the heat gradient from the rack bars and gate slots to the water so that no frazil ice will stick. No difficulty has been found with ice, as the approach velocity is very low, less than 1 ft. per sec., and the pond is completely frozen over all winter.



PARTICULAR ATTENTION WAS PAID TO EXTERIOR AND INTERIOR APPEARANCE

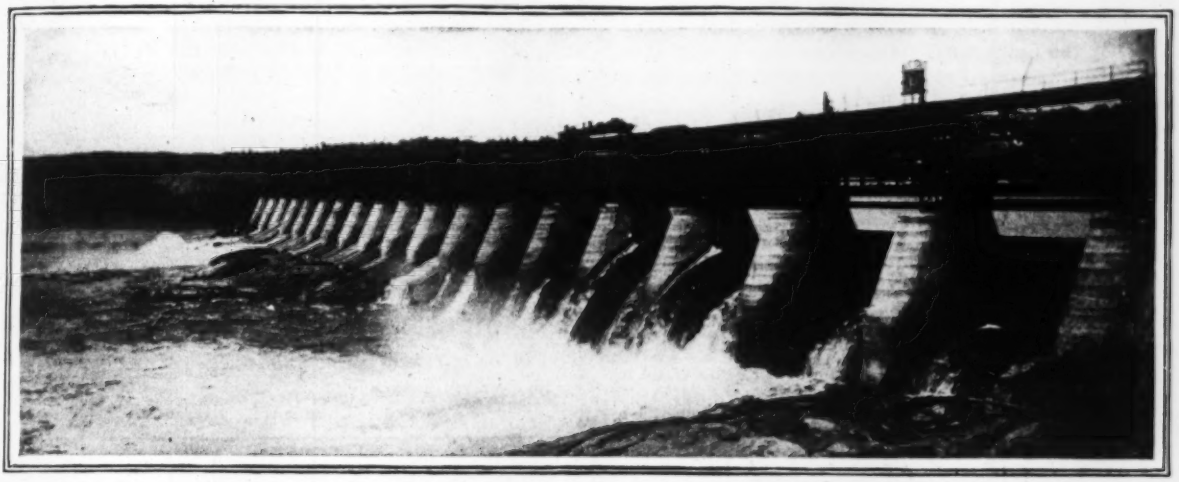
The generating units are single-runner, vertical-shaft Francis turbines developing 25,000 hp. at 120 r.p.m. under a head of 84 ft., and each driving a single direct-connected 6600-volt three-phase 60-cycle generator. The notable feature about these generators is the use of mica insulation with which operating temperatures of up to 125° C. can safely be carried.

The weight of the generator rotor and turbine runner (330,000 lb., including 40,000 lb. possible unbalanced hydraulic thrust) is carried entirely by a Kingsbury thrust bearing supported on bridge arms going to the generator armature frame, which transmits the load to the floor. The turbine speed ring serves as a line of interior supporting columns across the interior of the casing chamber.

The Kingsbury bearings are lubricated by oil from a central oil-supply plant coming by gravity through the Laurentide Co.'s well-organized engineering and construction forces with such few additions as would be needed instead of letting new construction contracts.

The winter of 1913-14 and 1914-15 brought added experience and knowledge of the behavior of a gate-controlled spillway under Canadian winter conditions, so that it was decided to change from the former plans of a solid spillway section of the dam with water level at El. 153, as previously planned, to a gated spillway with the normal water level eventually at 160. This plan resulted in a rise of 7 ft. of headwater.

This meant that the turbines which were originally designed to develop 20,000 hp. would produce 25,000 at the original speed. Being mica insulated, the generators, which were originally rated at 14,700 kv.-a. maximum load were capable of being safely run at the increased capacity without injurious heating.



ON THE CENTER STRETCH OF SPILLWAY ARE STEEL CREST GATES HANDLED BY A TRAVELING HOIST

metered duplicate lines. A separate line of oil piping runs to the upper auxiliary (guide) bearing. A small motor-driven pump inside each pit liner returns this oil to the pumping plant for filtering and re-supply. The lower guide bearing is a water-lubricated type with lignum vitæ strips.

The governor for each unit is driven by a lay shaft geared to the main turbine shaft. Water is supplied under 200 lb. pressure to the governors in duplicate pipe lines; the servomotor discharge comes back to the pump room by gravity, is filtered and repumped. The lubricating oil and water-pressure pumps are in a room in a mill building close by the station.

Changes Made on Resuming Construction After Shutdown

As already noted, work on the Laurentide plant was entirely shut down in the fall of 1914 to await the developments of the war, which had halted the old plans for financing. At that time the power-house substructure had been brought up above tail-water, the steel frame erected, and some of the concrete placed for the adjoining 320 ft. of dam and the 458 ft. next to the east bank.

About May 1, 1915, the financing was completed and work started again. When it was decided to complete the construction it was thought economical to employ

The consulting engineers, brought into the case at the time of the financing, advised reinforcing the power-house substructure against the greater hydrostatic load by adding concrete above the penstock and extending the tailrace piers downstream. This was done at a reasonable expense, although it delayed the final completion of the station several months.

In the adding of the downstream piers, it was decided to use concrete caissons and air, since the tailrace could not be unwatered with two generating units running. The concrete caisson, as noted in detail in *Engineering News-Record*, Apr. 19, 1917, was built on a platform between double rows of cross-braced piles, lowered by screws, sealed to the rock bottom and filled with concrete. The caissons thus sunk served as the new piers, and were heavily reinforced vertically and horizontally (being designed to act as a cantilever beam taking hydrostatic thrust) and anchored to the old concrete. A heavy deck slab was thrown across from pier to pier.

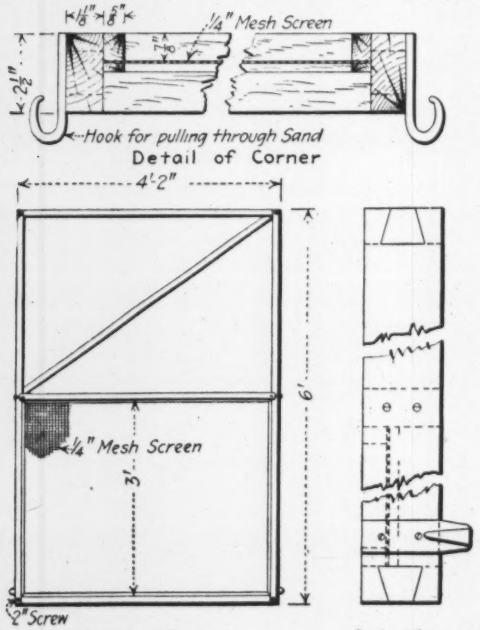
The Laurentide development was originally undertaken by the Laurentide Co., Ltd., the pulp and paper concern, of which George Chahoon, Jr., is president. The original design was made by George F. Hardy, of New York City, as the company's consulting engineer. The work until the shutdown in 1914 was done under contract by H. E. Talbott Co., of Dayton, Ohio. When

the financing was completed, a separate concern known as the Laurentide Power Co., Ltd., was organized to own the power development, and a contract was then made with the Shawinigan Water and Power Co. to operate the station and also to purchase the power—except what was needed for the Laurentide mills. Under these conditions the company completed the construction with its own forces, except that the tailrace caisson work was done under contract by Fraser, Brace & Co., of Montreal and New York. The work since resumption of construction has been in charge of E. B. Wardle, chief engineer of the Laurentide Co., Ltd.

The turbines were designed and built by I. P. Morris Co., of Philadelphia, and the governors by the Lombard Governor Co., of Ashland, Mass. The mechanical parts of the generators were made by the Westinghouse Electric and Manufacturing Co., of Pittsburgh. The generator armature windings, station wiring, switches, transformers and instruments were furnished and installed by the Canadian Westinghouse Co., of Hamilton, Ont. The Dominion Bridge Co., Montreal, furnished all the steel for the station structure, the headgates, traveling cranes and the gates in the dam.

Special Screen To Remove Mud Balls from Mechanical Filters

MUD BALLS in the filter sand which were formed during the first year the filters of the Chain of Rocks plant of the St. Louis water-works were in operation and which were probably due to the low rate of wash used during that period, were removed successfully by pulling a screen through the filter sand while it was being washed at a rate of about 8 to 10



A ¼-INCH MESH WAS FOUND MOST SUITABLE AFTER MUCH EXPERIMENTATION

in. vertical rise per minute, according to the annual report for 1916 of E. E. Wall, water commissioner. The screen illustrated in the accompanying drawing is operated by two men walking in the wash-water gutters and holding the screen in a vertical position while two men on top of the division wall pull the screen through the sand by means of ropes attached to the hooks at the bottom of the screen frames. It is necessary sometimes to pull the screen through the same portion of the bed as often as ten or more times, since the mud balls sometimes flow aside with the sand while the screen is being pulled ahead. The bottom of the screen, of course, is held down to the gravel, or as nearly to the bottom of the filter sand as is possible.

The entire bed is gone over in this manner, a special narrow screen being used between the wall and the first gutter. As much as 1,500,000 gal. of water are used during this process of screening.

Various experiments were made with screens of different meshes, varying from ⅛ to ½ in., and it was found finally that the screen with ¼-in. mesh, made of No. 14 wire, gave the best results. The lower half of the frame only is covered by the screen, but since there are only 30 in. of sand in the bed, the screen portion comes well above the normal surface of the filtering layer.

Professional Questions

Engineers are urged to send to the Editor comment on cases presented in this section or statements of their own experiences in matters of professional ethics.

Communications must be signed, but names will be withheld from publication, if the writer so desires.

Engineer Who Guaranteed Cost Got Job

Sir—An article in the "Professional Questions" column of *Engineering News-Record*, Oct. 11, p. 701, entitled "Public Officials Ask Engineers to Guarantee Cost," is of vital interest to many engineers and it is particularly so to us, as we are one of the firms involved, since the article evidently refers to the North Hill Viaduct at Akron, Summit County, Ohio. We wish to call attention to some facts that are not clear in the article.

The Watson Engineering Co., of Cleveland, Ohio, was employed by a committee of citizens to make preliminary studies, surveys and estimates for this viaduct for the purpose of determining its feasibility and as a basis for a bond issue to be voted upon by the taxpayers. The bond issue ($1,200,000) was approved by vote and the company was *subsequently* engaged by the board of county commissioners at the request of the county engineer (as provided by law) to assist the county engineer in making surveys, borings, studies, general plans and estimates for the structure, in order that the location and type of structure should be officially and legally determined. This was necessary to determine properly the compensation and damages due to property owners affected by the building of the structure and approaches. The data and plans prepared by the company were regularly adopted by the board and became a part of the official records on file, and subsequent settlements for compensations and damages to property were based on these and they became a part of the agreements.

One of the provisions of the contract between The Watson Engineering Co. and the board of commissioners was that all amounts paid for preliminary work were to be deducted from the fee for design and supervision of construction—the amount of the fee and other details being provided for in this arrangement.

After the construction of the viaduct had been officially decided upon, the board of commissioners, at the solicitation of some engineers, requested several engineers to submit propositions, estimates, etc., for the preparation of detail plans and supervision of construction. As will be noted by the letter from the commissioners, reproduced below, no guarantee of cost was requested. One engineer, however, criticized the original estimate of cost and stated to the board of commissioners that a structure could be designed at a much lower cost, finally guaranteeing to do this. All other engineers submitted estimates, but declined to guarantee the cost of structure and endeavored to have the commissioners make their selection on the merits of the abilities and qualifications of the engineers considered.

The commissioners, ignoring the county engineer's written recommendation for the engineers that made the original plans (The Watson Engineering Co.), finally selected the engineering firm that guaranteed to design a structure that would cost less than the amount originally estimated. The commissioners stated publicly and privately that the only reason for selecting this firm instead of the one that made the original plans was the guaranteeing of estimated cost.

The points that we wish to make are these: First: This was not an ordinary engineering competition, but involved an engineering firm that had done (very satisfactorily) much work for the county, had been selected to do this work and had been recommended by the county engineer (as required by statute) to continue it, but one particular engineer agreed, for obvious reasons, to guarantee an estimate below the official estimate.

Second: This is not a contingent fee case. It had been decided to build the structure, the bonds had been voted and the survey and the general plans for the structure had been officially and regularly adopted and made a matter of record, and it became a question of the engineers proceeding with the detail plans in the most economical manner, consistent with good engineering practice.

It is not, perhaps, unusual for architects or engineers to do work of a preliminary nature with the understanding that it is contingent upon the work being authorized later, but no such contingencies existed in this case. The guaranteeing of an estimate under such conditions puts the engineer entirely upon a contracting basis and tends to produce a structure that has to be built inside of a certain amount without regard to its character, instead of a structure that should meet all conditions of traffic and appearance. It is interesting to note that no bids were received from contractors on the designs made by the engineers guaranteeing the cost, in response to advertisement, although the structure as developed by them was designed for a much lighter live load than that provided for in the original estimate and was in many ways an inferior structure, in addition to omitting several items included in the original estimate.

We feel that this is an important matter to the engineering profession and that the facts should be presented to your readers in order that there may be free expression of opinion regarding it.

THE WATSON ENGINEERING COMPANY,
W. P. Brown, Principal Assistant Engineer.
Cleveland, Ohio.

[The letter from the county commissioners, to which Mr. Brown refers, follows]:

"Gentlemen:

Beg to inform you that the time for considering the selection of an engineer for the North Hill Viaduct to be erected in this city, has been set for Apr. 13, at 9:00 o'clock a.m.

We are enclosing herewith an information blank which we will ask you to fill out and file with this Board.

Respectfully,
SUMMIT COUNTY COMMISSIONERS."

INFORMATION BLANK

1. Are you a citizen of the United States?
2. Name of firm.
3. Length of time in business.
4. Financial references.
5. List of bridges designed costing over $50,000.
6. List of bridges now under construction or being designed costing over $50,000.
7. Give estimated and final costs of all bridges costing over $50,000 for which your firm has had complete charge.
8. The engineers selected will be required to execute a contract agreeing to design a structure that will cost not to exceed $950,000.
9. Percentage for detail plans, specifications, estimates, and general supervision of the work, including preparation and certification of contractors' estimates. Additional percentage for furnishing competent resident engineer devoting his entire time to the work and for all inspection work, including inspection and testing of all materials used and all concrete inspectors required, and also including all survey and laying out work required.
10. Plans and estimates of cost may be submitted if desired as additional evidence of the candidate's professional ability but preference will be given to work actually executed in judging such ability.
11. How soon after being appointed would you be able to have the detail plans ready so that contract could be let?

Why Not Have All Designs Checked by Outside Experts?

Would not the independent checking of plans and specifications for all important engineering works by experts who have had nothing to do with their preparation be a distinct step forward in engineering practice? The desirability of such a reform has been in the mind of J. A. L. Waddell, consulting engineer, for many years. He has now written to *Engineering News-Record*, expressing himself as follows:

If this independent checking of plans were practiced great disasters, such as the two failures of the unlucky Quebec Bridge, dam collapses, foundation settlements

and many other accidents to engineering structures too numerous to mention, could be avoided. It would add force to these claims were it possible to give a list of the most important failures of engineering works which have occurred during the past three decades; but so doing would raise animosities and cause hard feelings, which is something to be avoided whenever possible.

Without the aid of the law, it would be next to impossible to establish such a custom upon a firm and permanent basis; because, as it is, promoters of enterprises generally object to paying proper fees to first-class engineers for doing the necessary work of designing and supervision. If, in addition, they were compelled to pay some other high-priced engineer to check their engineers' work, they would consider that they were being outrageously imposed upon, and their protest would be both energetic and loud—reaching unto high heaven.

But in providing for the safety of the general public, the financial interests of no set of men should receive much consideration. The governing principle should be "the greatest good for the greatest number." The total amount thus paid for extra checking of plans would be a bagatelle as compared with the economies effected by the avoidance of the expenses of reconstruction, repairs and interference with business—to say nothing of the saving of human lives, which is something to which no money value can be assigned.

It is within the realm of possibility that at first there may be objections raised to this suggested innovation by some designing engineers; for they may feel that their rights and privileges are being encroached upon, their dignity offended, and their *amour propre* insulted.

No broad-gage engineer, however, ought to look at the matter in such a light, because he certainly should be pleased to have all his important work receive an extra check, and thus avoid even the most remote possibility of disaster to his constructions—and all this without any cost whatever to himself.

In order to obtain the greatest possible benefit from the proposed innovation, the work should be divided into two parts, first, the checking of the layout of structure or plant before any detail plans are prepared, so as to settle the question of economics at the outset; and, second, the checking of the final drawings, so as to eliminate all mistakes of computing and drafting.

There is likely to be more objection raised against the first step than against the second, as the designer may not like to have his economics questioned; but, again, if he be a broad-gage man, he will gladly adopt any modification of design which tends toward real improvement or true economy.

There is danger of friction arising between the original and the checking engineers, and this might be deemed a serious objection to the innovation. However, a little possible friction is not comparable in importance to the security against disaster that would in all cases be obtained, for it is almost inconceivable that two engineers, or two sets of engineers, working entirely independently of each other, should make the same error.

It should be understood *imprimis* that under no conditions would it ever be allowable to discharge the original engineer and put the checking engineer in his place, for that would always lay the latter open to a general, but usually unmerited, suspicion of unfairness. If the original engineer be found unfit to do the work, a third engineer should be employed in his stead, and the second engineer should check the third engineer's work.

If, Mr. Editor, you will open your columns to a thorough discussion of this suggestion by engineers in general, you will be conferring a favor upon the entire profession.

Charges for Professional Service

Sir—In reply to the first query of "Engineer" regarding proper charges for professional service, appearing in your issue of Nov. 1, p. 824, permit me to state that the 6% commission suggested by "Engineer" is insufficient should "Engineer" attempt to give complete professional service in connection with the proposed improvement. Should "Engineer" furnish the service which the Code of Professional Ethics of the American Institute of Architects prescribes shall be furnished, then I would say that for a job such as described by "Engineer" the actual cost in money to "Engineer" for handling the work will be at least 6% of the cost of improvement—7½% would be more nearly the proper charge.

Of course, if "Engineer" should furnish such service as is furnished by too many engineers and, I am very sorry to say, by many architects, then the 6% fee is too great. This kind of service briefly is as follows:

The preparation of very crude floor plans and elevations that contain practically no details and in many cases do not even indicate the structural design. Usually on such plans will be found a note reading as follows: "This building shall carry a load of —— pounds per square foot. The contractor to whom work is awarded will be required to furnish the structural design and details satisfactory to the engineer." The same proceeding is true with regard to practically all of the construction. It is left to the contractor to design the building. When it comes to electric wiring, heating, sprinkler equipment, plumbing, etc., no attempt is made to design anything. The plumbing is usually handled as follows:

"All work shall shall be installed in accordance with the requirements of the Health Department and —— fixtures shall be used." For the heating, instead of preparing a carefully worked out design on which competitive bids can be secured, there is note in the specifications that the contractor shall install a heating system to heat the building to 70 deg. temperature with zero outside temperature.

This is the only way these fellows can get away with their low commissions and not be compelled to accept commissions from material dealers or contractors. They do not furnish service; in fact, I am of the opinion that the price they charge for the service rendered provides a much greater percentage of profit than if a fee of 7½ or 6% is charged and complete service rendered. In fact, I am not sure but that any engineer or architect who will do less than provide complete working drawings and detailed specifications of every branch of the work is guilty of a moral, if not a legal, fraud.

F. E. DAVIDSON, A. I. A., M. Am. Soc. C. E.,
Chicago. of Davidson & Weiss, Architects.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

The Engineer Title

Sir—Emile Low's comment on the general misuse of the engineer title, in his letter appearing in *Engineering News-Record* of Aug. 23, p. 369, is quite correct.

The public in general gets wrong and confusing ideas, even from those who are supposed to know; and not until the word "engineer" is displaced, in cases such as those mentioned by Mr. Low, by a more suitable term, as for instance "machinist," which term signifies a person versed in the principles of machines, one who runs a machine or one skilled in the use of machine-tools, and not until such term is accepted officially, as it is all over Europe, England excepted, can we make reasonable complaint against the misuse of the engineer title.

Shanghai, China. H. BERENTS.

Lighting a Drafting Office

Sir—I was very much interested in the account of the lighting of a large drafting office of the Northern Pacific Ry., which appeared in your issue of Oct. 4, p. 662. The article states that: "Photometric tests with 100-watt 'C' lamps previous to installation gave an average of about 8 foot-candles at 2½ ft. above the floor level."

Since there is one 100-watt unit for each 9 x 8 ft., or 72 sq.ft., an illumination of 8 foot-candles would mean an efficiency of utilization of $8 \times 100 \times 72 \div 1260$, or 46%. It is improbable that an efficiency of utilization of 46% could be obtained by indirect lighting. It is therefore assumed that the preliminary photometric tests were made with direct lighting.

The entire illumination for the period from December, 1915, to the fall of 1917, with 100-watt lamps, was evidently approximately $1260 \times 0.25 \div 72$, or 4.4 foot-candles. It has been the writer's experience that the usual indirect lighting system suffers a deterioration of approximately 50% during its first year's use, due to the lack of proper maintenance. In the fall of this year, therefore, the illumination was approximately 2.2 foot-candles. In consideration of the fact that from 8 to 15 ft. is required for drafting, there is little wonder that unsatisfactory results were obtained.

When the 150-watt "C" lamps are installed, it is very likely that the reflector will be cleaned, and an initial illumination of $2050 \times 0.25 \div 72$, or 7.1 foot-candles will result. Should 200-watt "C" lamps be used, an initial illumination of $2920 \times 0.25 \div 72$, or 10 foot-candles, would result. It has always been the writer's practice to allow a factor of safety of 25% for the fall in illumination between periods of cleaning. The 200-watt "C" lamps would therefore be satisfactory, assuming that the ceiling is in good condition.

It is noted that 80-watt "C" lamps are used in those portions of the room where no drafting work is done. There are no 80-watt "C" lamps listed, so I presume 75-watt "C" lamps are used. If this is direct lighting, an intensity of approximately 5.5 foot-candles would be obtained: $865 \times 0.46 \div 72$. This is the correct intensity for office lighting. If 75-watt "C" lamps are used in the indirect fixtures, however, the initial illumination would be only $865 \times 0.25 \div 72$, or 3 foot-candles; and with a deterioration of 50% it would be only 1.5 foot-candles.

For the past six months I have been coöperating with the Industrial Commission of Wisconsin in establishing suitable minimum standards of illumination, and in conducting an educational campaign for better lighting among the manufacturers and employers of Wisconsin. A large number of illumination surveys have been made in factories of the state, and the need for more adequate illumination and better maintenance of the lighting units has been emphasized. DAVIS H. TUCK,
Illuminating Engineer, U. S. Public Health Service.
Madison, Wis.

[The letter printed above was submitted to H. E. Stevens, chief engineer of the Northern Pacific Ry., and his reply follows.]

Sir—Your letter of Oct. 22 is received, with copy of comments made by an illuminating engineer on the lighting of the Northern Pacific drafting room. The tests referred to in our article were made with the indirect fixtures, which were at the time brand new. The ceilings were also new, likewise the lamps. These were 75-watt "C" lamps, but at that time were rated as 80-watt, the tests being made before the lamps were openly placed on the market.

The results given by the averages of a number of tests with these new lamps showed a greater efficiency than 100-watt lamps which had been burned about five months and used in the same fixtures. The 200-watt "C" lamps are now installed in the drafting room as originally planned, and the results are entirely satisfactory.

Your correspondent has evidently had the common experience of all of us as to the difficulty in keeping clean the reflectors of the indirect lighting system. This, it seem to me, is their greatest drawback. These reflectors are natural dust catchers and so inconvenient to get at that they are very apt to be neglected. I think the factor of safety he assumes of 25% between periods of cleaning is quite conservative.

H. E. STEVENS,
Chief Engineer, Northern Pacific Ry.
St. Paul, Minn.

Areas of Segments of Circles

Sir—I have worked out a formula for areas of circular segments which your readers may find useful at times. The formula is

$$A = al\left[\frac{2}{3} + 0.475\left(\frac{a}{l}\right)^2\right]$$

where A = the area of the segment, a, the altitude, or mid-ordinate and l, the length on the chord.

This formula gives the area of any segment not greater than a semicircle with a maximum error less than ½ of 1 per cent. The results are always low. The formula is not suitable for use with logarithms, but the slide-rule handles it well, giving the quantity $0.475(a/l)^2$ in one setting. It will frequently be close enough to use ½ instead of 0.475.

The formula is derived as follows: When $a/l = 0$, $A = 2al/3$. When $a/l = \frac{1}{2}$, $A = \pi al/4 = (\frac{2}{3} + 0.1187)$ al. The coefficient of al is seen to be greater than $\frac{2}{3}$ by a quantity which varies from 0 to 0.1187. Assuming that this quantity is proportional to $(a/l)^2$ the general formula becomes,

$$A = al\left[\frac{2}{3} + 0.1187 \times 4\left(\frac{a}{l}\right)^2\right]$$

$$= al\left[\frac{2}{3} + 0.475\left(\frac{a}{l}\right)^2\right]$$

The formula is simply an approximate interpolation. If the interpolation were on the basis of a/l instead of $(a/l)^2$ the maximum error would be about 4% and all results would be high.

L. H. DOOLITTLE,
Corporal, Company F, 313th Engineers.
Camp Dodge, Iowa.

The Engineer and His Looks

Sir—Looking backward over fourteen years' experience in the railway game, I recall the boast of more than one man that his rodman had been mistaken for the engineer—the rodman, especially if a "new" man, having been the best dressed, best appearing man in the party.

I recall the relation of an incident, in which a grading foreman, believing the man appearing before him to be a tramp, attempted to hire the construction engineers.

I recall the joy with which Division Engineer B—— C—— told of his "cussing out" a Pullman conductor. Mr. C—— had been on the "line" a week. He brought muddy boots, dirty, torn clothes and whiskers back with him. The conductor put him in the class to which he appeared to belong and barred his entrance to the Pullman.

I recall the revocation of a privilege granted by a large railroad to its engineers, permitting them to ride in a certain through train. The appearance and actions of the men permitted to use it had proved inconsistent with the desire of the management to attract a certain class of patronage to that train.

I wonder what effect such conditions have upon the judgment of layman and employer on the position of the engineer in life, and to what extent they may be responsible for advertisements such as the one noted in your issue of Oct. 11, p. 673.

N.

Serial Bonds for Road Building

Sir—The writer has studied with some care and considerable interest the article of M. O. Eldridge in the *Engineering News-Record* of Aug. 30, captioned "Serial Bonds for Road Building Save Money," but he differs with some of the conclusions, particularly with those based upon the mathematical comparisons of the three methods. A thorough study of the subject will show that as far as the mathematics of finance is concerned there is a definite law of conservation of value through all the various stages of the process of amortization.

Mr. Eldridge has neglected to make the comparisons of the different methods in a fair way, in that he has fallen into the error of simply adding the various annual payments, without regard to the time they were made, or their amount, and then striking a balance. It would appear that this error is a common one among investigators in the field of finance. The writer had occasion (*Engineering News-Record* of May 10, p. 324) to point out a similar error in W. H. Connell's study.

The only way to strike a balance is to refer the different methods to a common point in time on the basis of value at that time. The easiest way to make such a comparison is at the beginning of a period, as we can then take the various "present worths" from the tables of Bulletin No. 136, which Mr. Eldridge has so frequently quoted.

The requirements for the sinking-fund method of Mr. Eldridge's example is $7536.10 annually for principal and interest. The present worth of an annuity of this amount for 20 years at 4% is $102,415. The annual requirement under the annuity method is $7358.18. The present worth of this annuity is $100,000, the cash value of the improvement.

The present worth of the serial method is more complicated. It is the sum of 20 annual annuities as follows: One of $5200 for 20 years; one of $200 for 19 years; $200 for 18 years; $200 for 17 years; and so on. The total is $100,000.

This shows that there is no advantage whatever in the serial method over the annuity method, and $2425 advantage over the sinking-fund method. Mr. Eldridge's results are therefore in error in stating that the serial method possessed an advantage of $8722 over the sinking-fund method and $5163 over the annuity method.

Now, Mr. Eldridge has figured the sinking-fund at 3½%. This is, to the writer's way of thinking, unfair, because there is nothing to prevent a community's sinking-fund commission from buying its own bonds, and this is frequently done. Furthermore, for purposes of comparison the value of money should be the same for both purposes in a community with any financial standing whatever. If, then, the sinking-fund had been computed on a 4% basis instead of 3½% the annual charge would have been $7353.18. This result would indicate that there is no pecuniary advantage in any of the three methods.

As regards the opportunity for mismanagement and its concealment under the sinking-fund method, the writer agrees that the serial method offers advantages to the public in that any irregularity will be indicated as soon as it occurs.

Mr. Eldridge has overshot the mark in his enthusiasm for the serial method and has thus laid it open to suspicion. The problem of introducing sound financial methods in communities unused to such processes is difficult enough without the introduction of errors in calculations.

The law of conservation of financial values is of no less universal application than the law of conservation of energy.

ADOLPH J. POST.
Shirley, Mass.

Macadam Roads in the War Zone

Sir—I have been very much interested in the article covering the subject of macadam roads under war traffic and the several comments made thereon as appearing in later issues. I have had the opportunity quite recently to talk with one of the American ambulance drivers who has returned from the French front after about nine months of active service in that section. He advises me that *very often* great holes are torn open in the roads, due to bursting shells and that in some places the traffic has been so continuous that

when anything went wrong with one of the vehicles it had to be ditched in order to prevent congestion on the road.

From what I have read and learned from talking to men who have been under fire in this great European war, it seems to me that it would be impossible to maintain, as suggested in one of the criticisms of your editorial, a concrete road under such damaging fire. One does not have to stretch the imagination very far to realize that the natural advantages of the concrete road over the plain water-bound macadam would necessarily be a negligible factor. If the traffic upon the battlefield highway was, as has been stated, virtually continuous, and at frequent intervals the concrete surface was torn open by bursting shells, such a structure would in a very short time become a series of patches over which the traffic would no doubt find fully as much difficulty in passing as over the crude macadam now constructed in the French battlefields. In other words, it seems very foolish to me to try to point out the advantages of higher classes of pavements over the simple water-bound macadam unless it can be definitely shown that those battlefield highways are subject to only the wear caused by the traffic.

G. R. BASCOM,
Municipal and Sanitary Engineer.
Madison, Wis.

Extra-Work Payment Clause in Miami Specifications

Sir—I note the letter of Mr. Victor Windett on page 895 of your issue of Nov. 8, and I wish to express my agreement with his views.

In my experience, both as an engineer and in contracting, I have found that many contractors appear to assume that a margin of 10% or 15% over and above the actual cost of material and labor will cover overhead and general expense, plant, profit and contingent expenses, whereas it is a fact that the proper charges for plant and overhead expense will exceed 10% on large contracts and will often reach 15% on medium-sized contracts.

In making preliminary estimates engineers too often omit the expense properly chargeable to the cost of construction, and this is one of the reasons why proposals so generally exceed the amount of such estimates; another reason being that, unless an engineer has had sufficient contracting experience, he is unable to understand or appreciate the difficulties that the contractor will have to meet and overcome, the risks that must be taken and the additional time that may be required over his time limit.

JAMES RITCHIE,
Civil Engineer.
Cleveland.

Shall Engineering Courses Be Made Shorter?

Sir—Referring to your editorial of Nov. 8, p. 864, on the shortening of Princeton University's engineering course, it may be of some interest to learn how the college of engineering of West Virginia University has met the war situation. By continuing the work of the junior year through the summer of that year and by slightly decreasing the required work, the class which would normally graduate next June will receive their degrees the middle of the coming December. The decrease in the required amount of work was brought about by dropping thesis and some optional courses—the whole amounting to eight credit hours, or about 4½% of the whole course. The reason for lowering the requirements was two-fold; in the first place it served as an inducement to the student to continue work during the summer and in the second place it was felt that these special courses could well be dispensed with at this time.

The results have amply justified the modification of the curriculum. The students did a better grade of work during the summer than they usually do during the regular semester. This was probably due to a number of reasons, such as the absence of outside activities—athletics, dances, fraternity loafing, etc.—concentrating the work by giving fewer courses at one time, and a more serious attitude due to the presence of war.

The real test of carrying school work through the summer is its effect on the work of the regular school year. In general it may be said that the work of the fall semester has been satisfactory although it is apparent that the long summer grind has taken away some of the freshness and enthusiasm from the student's work.

The present conditions justify intensive school work, but *Engineering News-Record* is correct when it states that "study, as such, is not a process that can be carried on continually."

ROLAND P. DAVIS,
Professor of Structural and Hydraulic Engineering,
West Virginia University.
Morgantown, W. Va.

Asphalt at Columbia Cantonment

Sir—We note with interest a letter regarding the paving at the Louisville cantonment, published in your issue of Nov. 8, p. 893. In this connection, permit us to state that the contractor for the Columbia, S. C., cantonment has informed us that in laying the roads for this cantonment he first used a car of Aztec asphalt, then a car of Bermudez asphalt, and after a demonstration of both it was decided to use Aztec asphalt exclusively in the paving work at the Columbia cantonment until completed.

UNITED STATES ASPHALT REFINING COMPANY,
J. R. Draney, General Sales Manager.
New York City.

Let Road Building Continue

Sir—Now is the time for all good men to discuss military roads and priority order No. 2. While it is true that certain highways in time of invasion, in the event of our railroad systems failing us, may be used primarily for the mobilization and maneuvers of troops, artillery and supplies, these highways will be few in number and mileage. Moreover, since this war is as much a war of food and other resources as it is of manpower and ammunition, it is my conception of the road situation in America that every road in the land is a military road. It would be strangely inconsistent for us to proclaim that the bushel of wheat or pound of beef produced in some remote part of our land is war food which may win the war, and at the same time fail to recognize that the road over which it may travel

in order to go to our allies or to our own people is intrinsically a military highway. World's commerce is not confined to intercourse from port to port, neither does it begin at the factory or mill. World's commerce—according to a precise view—begins rather in a trap or seine, at the mine's mouth, in the lumber camp, on the ranch, or at the farmer's door. And world's commerce today is war commerce, which makes every highway in the land a military road.

While we may recognize the emergency which prompted the issuance of priority order No. 2 and may admit that coal is more important now than sand, gravel, broken stone, etc., yet the situation may prove to be a relapse to the early war-cry of curtailing road and bridge work. Let us not forget that the development and conservation of our resources is unusually intimately connected with continued, if not increased, development of all of our highways. The earliest possible recission of priority order No. 2 is the least that can be done for the good of the cause. In the meantime, let the good work for highway planning and improvement go on. J. E. KAULFUSS,

Highway Engineer, North Dakota Highway Commission.

Bismarck, N. D.

Right-of-Way Computations

Sir—Referring to your issue of Sept. 6, p. 439, the distance along the right-of-way line on a simple curve can be found by the formula, $x = D \pm DO/R$ where D is the distance along the center line of the curve; R, the radius of the curve, and O, the offset to the right-of-way.

In the example given by Mr. Sanow, where $D = 254.9$, $O = 33$ and $R = 1206.57$ it is necessary only to solve $254.90 \times 33 \div 1206.57 = 6.97$ and add to $254.90 = 261.87$, which is the value of x.

This method avoids the calculation of the value of A in Mr. Stevens' formula. R. B. COLLINS,

Assistant to Division Engineer, Pennsylvania R.R.

Buffalo.

Formula for Haul, Waste and Borrow

Sir—In my article in *Engineering News-Record* of Aug. 9, p. 260, the following correction should be made:

"d, cost of hauling and dumping material taken from cut to fill, per cubic yard hauled 100 ft."

The words "100 ft.," left out of the article as printed, are essential if the formula is to produce exact results. W. C. WEST,

Highway Engineer, Bureau of Public Works.

Manila, P. I.

Railing Designed To Withstand Auto Collision

Sir—The caption to the second cut in the article by H. K. Higgins in your issue of Oct. 4, p. 653, indicates that a concrete railing is unsafe under the impact of a colliding automobile. To this point of view I desire to take exception, knowing from experience that a railing adequate to this purpose can be designed, in fact has been designed and used by the New York State Department of Highways. This rail has been through numerous accidents and in no case has failed to perform its duties. In other words, no vehicle has gone through the railing.

The rail illustrated is not scientifically designed, being merely a concrete substitute for wood, lacking entirely the transverse strength which wood has. From the illustration it can be seen that the effective depth of the concrete in this rail is exceedingly small and the reinforcement is therefore inefficient. On the other hand, the standard rail of the New York State Highway Commission has been carefully designed and the present detailing was arrived at after a thorough study and many practical experiments. The rail is reinforced for tension and for horizontal and diagonal shear.

The two designs are utterly different. To the inexperienced reader it might appear that reinforced-concrete railing in general has not given satisfaction. It is the broad statement of the caption, not the picture of the broken railing, which is objected to. It must be recognized that the function of the railing is not necessarily to remain intact after a blow from a vehicle, but that it has served its real purpose if it prevents a vehicle from going through the railing and down the embankment on the other side. This is what the standard railing of the New York State Department of Highways does. G. C. WRIGHT,

Assistant Engineer, Monroe County.

Rochester, N. Y.

A Difficult Problem in Chaining

Sir—In a recent survey made by the writer, a 300-ft. steel tape was used whenever possible because, although there was a 100-ft. tape in the party's equipment, only the longer tape had been standardized by the State Bureau of Weights and Measures. In some cases the use of the longer tape made it impossible to hold both ends at the same elevation, and in one case the tape touched the ground at a point near the midlength. While this was known and measurements were taken so that

corrections of proper magnitude might be made for this unusual condition, I found my mathematical equipment too meager.

While it seemed possible to figure corrections on the basis of the tape hanging as a catenary just as if the ends were at the same level, and then correcting for the cosine of the angle, I was not certain how much error this would involve.

The conditions of the problem are shown in the accompanying sketch. A, B and C are the three points of support, all at different known elevations, and point B is assumed frictionless. The pull on the tape at C is known in pounds, as are the constants of the chain, and the temperature and the reading of the tape at A, B and C. I ask your readers whether they can supply an exact solution of this problem; but, if this is not practicable, even an approximate method would be of help not only to the writer but no doubt to many other engineers who have been tempted to make measurements under similar conditions. DUDLEY PAUL BABCOCK.

Albany, N. Y.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Trussed Booms Mounted Over Columns Double Speed in Erecting Steel

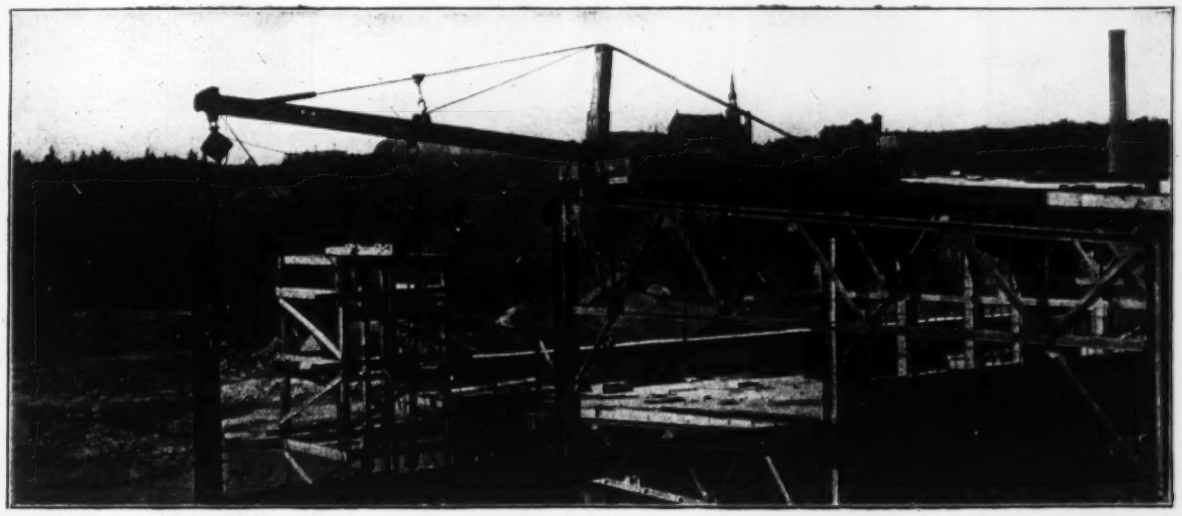
By L. R. Talbot
Three Rivers, Quebec

TIMBER booms resting at the center on previously erected columns and rigged with a single main fall, as shown in the photograph, were used in erecting the new power house of the Laurentide Co. at Grand' Mère. This power house has nine units, each consisting of two bays 22 ft. wide. The first contractor did not use this rig, but started to erect the steel work with "Chicago booms." These so-called booms were of timber about 30 ft. long, and were attached to the last column erected. The foot block was a heavy casting attached to the column with U-bolts about 15 ft. from the top, the bottom falls being attached to the top of the column. The boom fall line and load line were carried to an engine on the ground floor. After the two columns and a truss ahead had been erected it was necessary to dismantle the entire rig and reërect it on the next bent. This operation took the greater part of a day.

After the work was taken over by the company the method shown in the picture was substituted. It originated with John A. Wiener, superintendent of construction, and was worked out with the writer, who was engineer on the job.

Two booms 45 ft. long were used. These were trussed on top as shown and mounted on the purlins of the last bay erected. The back end was chained down to the next truss behind and tightened with wedges. The fall line was carried to the drum of an engine on the ground as in the other scheme. An independent falls was attached in the center of each boom for erecting the connecting beams. The booms were given enough elevation to raise the trusses without any trouble.

After a bent of steel was erected and the purlins were placed, it was only the work of a few minutes to unchain the booms and slip them ahead to the next position and chain them down again. After they had proved themselves a success a large U-bolt was made to anchor them down, which simplified the work. This rig more than doubled the speed of the erection.



AFTER NEXT TRUSS IS UP, BUT A FEW MINUTES ARE REQUIRED TO SLIDE BOOM AHEAD

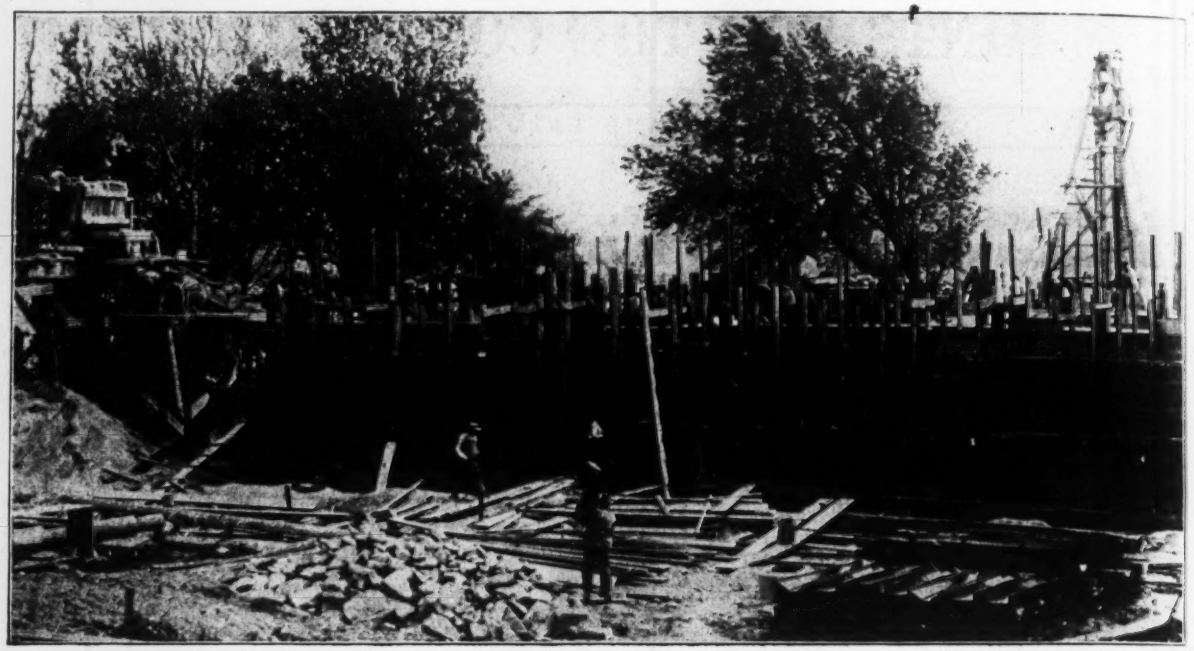
Concrete and Fill Placed Quickly by Car and Incline

By George W. McAlpin
Engineer in Charge, U. S. Dam 33, Ohio River, Maysville, Ky

MIXED on a tower boat, chuted to a specially constructed car, hauled to the top of a hill on a trestle and there dumped into a hopper to be carried away by concrete buggies, concrete was cheaply placed at Dam No. 29, Ohio River, for the land power-house foundation.

The power-house foundation is being built on the first bank, 30 ft. above the level of, and 350 ft. back of, the land wall of the lock. The job consists in building a concrete foundation of 590 cu.yd., making a 5000-yd. fill and connecting power house to the top of the bank by a concrete roadway.

The mixing plant, described in *Engineering News* of Feb. 1, p. 270, is of the floating type, and carries two mixers and the tower. The mixers on the boat were the only ones available and could not be removed without destroying value of this part of the plant; it was therefore decided to place the boat alongside the land wall and chute concrete to a car to be carried to top of hill. The car, holding a hopper and dumping on the side, was constructed from material on the job, and after completing the concrete work was used to place fill for the terrace. The car was operated by means of



CAR AT LEFT PULLED UP INCLINE FROM MIXER BOAT BY HOIST AND RETURNED BY GRAVITY

cable and hauling engine and returned by gravity. A trestle at the top of the bank brought car to a suitable level so that concrete dumped into a hopper could be taken away in buggies.

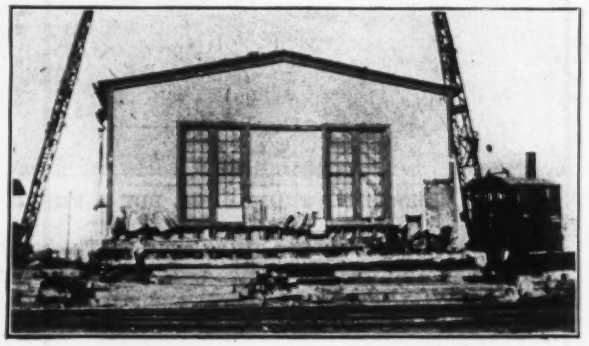
In making the 7-ft. fill material was unloaded from barges by a derrick boat into a hopper discharging into the car, which carried it to the top of the hill and dumped it from the trestle. The material was distributed by a crane using a clamshell and by wheelbarrows. Fill was placed at rate of 300 cu.yd. and concrete at rate of 200 cu.yd. per 8-hour day, the car making the round trip to top of trestle and back in less than 1½ minutes.

Cranes Move Twenty-Five Ton Wooden Building Half a Mile

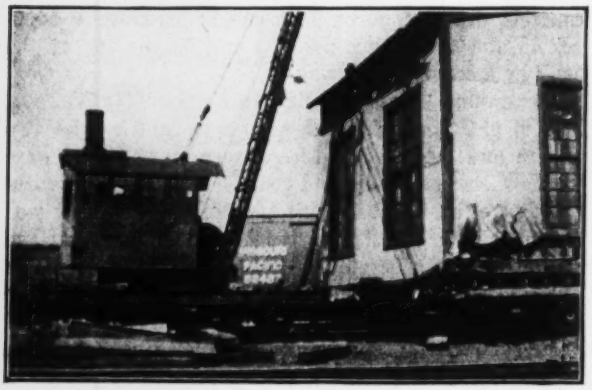
By John H. Sawkins
Jersey City, N. J.

TWO 15-ton locomotive cranes recently picked up a 25-ton wooden frame building 35 x 42 ft. in plan, and 22 ft. from the floor to the peak of the roof, and moved it from the old Pennsylvania R.R. car repair yard at Greenville, N. J., to the new yard now being constructed just north of the old site.

The building was first reinforced with 6 x 12-in. yellow pine timbers, bolted around the lower edge of the four walls, and 12 screw-jacks, each of 10 tons capacity, raised the structure high enough to allow three 50-ft.



CRANES HAD TO KEEP THEIR DISTANCE



LOAD WAS CARRIED BY THREE 50-FOOT PILES

yellow pine piles to be slipped under the building, their ends projecting 4 ft. beyond the wall at either side. The pile placed in the center of the building was connected at its middle point by two 4 x 12-in. yellow pine timbers to the central truss of the structure. This gave additional stiffness to the two end walls and the end piles added stiffness to the two side walls. The carrying piles were securely bolted to the 6 x 12-in. timber mentioned above. Two slings, each consisting of three loops of three 4¼-in. cables, were connected to the projecting ends of the piles, three turns of the cable being taken around each of the pile ends to reduce cutting action.

Since the maximum allowable load for each of the cranes was 30,000 lb. at a 10-ft. radius, it was assumed that each crane would be taxed to about its maximum

allowable load, since their booms were extended to a 12-ft. radius during the period of moving. The utmost precaution was taken to keep the cranes at the same distance apart, since they were not connected in any other way than through the building itself. Any separation would have thrown an unusually severe load on the crane and might have precipitated failure.

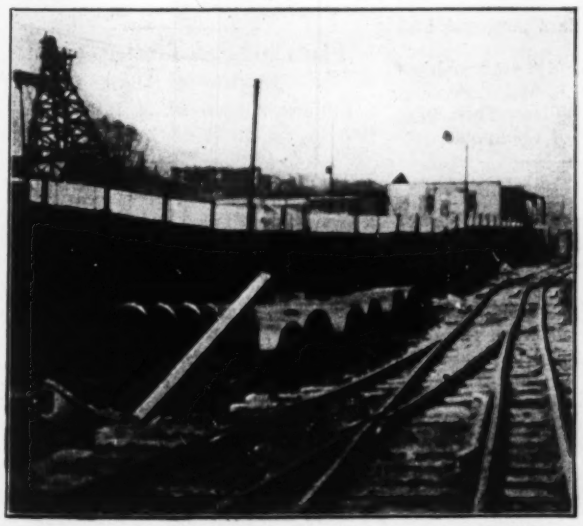
The contractor for the work was Henry Steers, Inc., New York City, and the superintendent in charge, A. R. Moxter.

Build High Fence Around Job To Save Theft of Tools

THE SITE of the clear-water basin at the Cleveland, Ohio, filter plant, together with the property on which the contractor's concrete plant for doing the work was situated, was inclosed in a plank fence more than half a mile long, the only openings in which were a gate for wagons and the workmen at the northeast corner of the basin, and a few gates, kept padlocked, across railway tracks. Ottomar Stange, of the John F. Casey Co., contractors for the relining of this basin, described on page 962 of this issue, figures that the cost of the fence will be saved in small tools and supplies usually lost on a contract job of this size through the peculations of workmen and the operations of local thieves. With the fence, a single watchman is able to look after the work, and men are not so liable to steal wrenches and rubber packing when they know they must pass through a single gate under this man's eye.

In addition, the fence represents a large potential saving in liability for injury to the public. It would not be safe to have self-constituted representatives of the taxpayers wandering over the surface of a concrete roof cut full of holes, and it would have been difficult to keep them off by other means.

The fence, 2700 ft. long, is made of 4 x 6-in. posts 12 ft. long, to which 11 rows of 1 x 8-in. plank are nailed solid on the outside. This is surmounted by three strands of barbed wire tacked to 2 x 4's nailed to the large posts.



HIGH FENCE SAVED TOOLS AND REDUCED LIABILITY

Shovel on Track with Plank Platform Does Not Fear Slides

REVOLVING steam shovels mounted on platform tracks, and having flanges fitted to the broad-faced traction wheels, are found to move with the toe of a sliding bank instead of being buried with the slide. They are thus ready to start clearing up the material when the movement stops. This method is used for the brickyard shovels of the Duffney Brick Co., at Mechanicsville, N. Y.

STEAM SHOVEL MOUNTED ON TRACK WITH PLANK BASE MOVES WITH SLIDING BANKS

The flanges are put on the inner edges of the wheels, as shown in the picture. The track sections have a plank base 9 x 6 ft., each platform carrying four ties with 6-ft. rails. With the wide-faced wheels mounted on rails it is possible to turn sharp corners by placing the platform sections on chords of a circle and putting in a 4-ft. section of rail to fill the gap on the outer side.

Many Activated-Sludge Plants

About 25 experimental activated-sludge plants have been built in various parts of the world, according to a paper read recently by T. C. Hatton, chief engineer, Milwaukee Sewage Commission, before the American Public Health Association. Of these one was in India, seven in England, and fourteen in the United States. Seven treatment plants have been built in the United States and four more of considerable magnitude are proposed.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Government Takes Steps To Solve Housing Problem

National Defense Council Recommends Aid, Financial and Otherwise, in Care of Labor Supply

In aiding the efforts being made to solve the housing problem, which is hindering war work, the National Defense Council, by its committee on housing, recommends Government aid, financial and otherwise. In its report, which has the approval of President Wilson, the committee asserts that an organization of "reasonable permanency and authority" is necessary to administer such funds as may be available for housing purposes. It recommends that the organization be granted broad powers to conduct building operations, to deal in real estate and securities, and to borrow and loan money. The committee further suggests that the Government loan funds for housing at low interest to those communities which can show the need for aid. It recommends also that in future Government agencies making war contracts give due consideration to the labor supply and housing conditions, and that future contracts be distributed as far as possible to prevent undue concentration of workers in any one locality.

It is suggested that concerns which take Government contracts and provide homes for workmen be remunerated by the Government if additional expense is incurred. Otto M. Eidlitz, New York architect, is chairman of the committee.

Laud Catskill Aqueduct Engineers at Commemorative Meeting

A glowing tribute to the New York Board of Water-Supply, to J. Waldo Smith, its chief engineer, and to the engineering staff, was paid at a meeting held Nov. 14 by the four national engineering societies to commemorate the completion of the main unit of the Catskill Aqueduct. The meeting, whose program included addresses by Mayor Mitchel and President Charles Strauss, of the board, and a nontechnical illustrated description of the project presented by A. D. Flinn, deputy chief engineer of the board, was open to ladies, and it taxed the capacity of the auditorium of the Engineering Societies Building in New York.

Mayor Mitchel characterized the Catskill Aqueduct as the greatest engineering achievement, and spoke enthusiastically of the skill and integrity of the organization, from board to engineering staff. He mentioned the moving on of several of Mr. Smith's assistants to other important work in New York and elsewhere, and expressed his appreciation of the place the engineer must occupy in building the city, the state and the nation. Mr. Strauss, called upon because of the inability of General Goethals to be present, disclaimed for the board any great part in the success of the undertaking except in the good judgment or luck displayed in its choice of a chief engineer. He pointed out that the cost of the work to date was $9,000,000 under the estimate, and that water was delivered a year and three months ahead of time. Mr. Smith, called upon for a few words, commended the noninterference of the board in technical matters and the loyalty of his staff.

Mr. Flinn gave a graphic account of the project, illustrated by excellent colored lantern slides. George H. Pegram, president of the American Society of Civil Engineers, presided at the meeting.

Government Calls for Men with Motor Truck Experience

The motor section, carriage division, of the office of the Chief of Ordnance, United States Army, will need several thousand skilled men for its work. This section is intrusted with securing all the special motor-driven vehicles for the War Department—such vehicles as four-wheel-drive trucks, caterpillar tractors, armored cars and tanks—and for work in connection with the maintenance and repair of this equipment and of Field Artillery, artillery carriages, trailers, recoil mechanism, etc.

Men with experience as mechanics, machinists, blacksmiths and storage-battery experts are wanted. There are four ordnance training camps where men with mechanical ability enlisting for the Ordnance Department are sent for special instruction to fit them for the grades of first-class sergeant and ordnance sergeant.

Those wishing to enlist may address the Chief of Ordnance, Motor Section, Carriage Division, 1703 New York Ave., Washington, District of Columbia.

Decision in Lower Otay Dam Case

That the destruction of the Lower Otay Dam was due to the unprecedented floods of January, 1916, and was in no manner traceable to the want of care or prudence in the maintenance of the structure, is considered to be the judicial finding announced in the judgment of nonsuit granted on Nov. 1, in the case of James vs. the City of San Diego, Calif. The case was tried in the Superior Court of Orange County before Judge Z. B. West, and was the first one tried upon its merits involving the failure of the dam.

Bids Opened for the Miami Conservancy Works

All Rejected But Three, and These Are Held for Further Consideration—Bids Exceed Estimate

All proposals on the twelve contracts for flood-control works of the Miami Conservancy District, Ohio, except on two of the items, were informal and conditioned on prices of labor and materials, on the attitude of the National Government toward construction work, or on other possible developments. The works were described at length in *Engineering News-Record* of Oct. 18, p. 728, and will involve an expenditure of $10,000,000. Some of the proposals indicated unit prices not far from the estimates of the district, but the conditions attached would make the final price indefinite. All proposals were rejected except those of R. H. & G. A. McWilliams on contracts 41, 43 and 44, covering about $1,000,000 of channel improvements at Dayton. In these the conditions were such as to make the maximum cost about 10% over the engineers' estimate. These three proposals have not been accepted, but are held for further consideration.

Proposals were received from: H. P. Converse & Co., 88 Broad St., Boston, Mass.; United Dredging Co., Seattle, Wash.; R. H. & G. A. McWilliams, 998 Crete St., Chicago, Ill.; Parsons Construction Co., Security Building, Binghamton, N. Y.; M. C. Connors & Co., 601 West Madison St., Chicago, Ill.; Winston & Co., 12 North Seventh St., Richmond, Virginia.

Hunkin-Conkey Co., Cleveland, presented unconditioned proposals on two dams, but these were received after the bids had been opened and read, and so were not considered.

Plans and Specifications of an Engineers' Dinner

Engineers engaged in the construction of Camp Zachary Taylor, Louisville, Ky., showed on Nov. 10 that they were worthy rivals of Brillat-Savarin in designing a menu. The occasion was a testimonial dinner by appreciative associates given to A. J. Sackett, chief engineer, Mason & Hangar Co. The menu, which was ingeniously called an "inventory," was as follows:

Yellow Pine Cocktail; Blueprint Cocktail; Salary; Olives; Asbestos Covered Almonds; Cream of Tomato, au Remount; Broiled Spring Chicken, au Shiplap; Cauliflower au Concrete; French Peas; Asparagus a la Militaire; Hearth Brick Cream; Petit Fours; Rattrap Cheese; Two-Ply Crackers; Di Mi Tessie! Excess.

Engineering Societies Entertain British Representatives

On Tuesday evening, Nov. 13, the four leading national engineering societies and the United Engineering Society entertained at dinner at Delmonico's, New York, the representatives of the Labor Division of the British Ministry of Munitions, who have been in this country for some months, discussing with American manufacturers and labor leaders the methods used in England for solving the labor problems which have arisen on account of the war. This was the only public function held in honor of the British representatives during their stay in New York.

Col. John J. Carty, U. S. R., chief engineer of the American Telephone and Telegraph Co., presided, and introduced, in turn, Gano Dunn, president of J. G. White Engineering Corporation, who extended a welcome to the mission, Sir Stephenson Kent, H. W. Garrod and G. H. Baillie.

The dinner was attended by a large and representative body of engineers.

Bridge of 3000 Feet Moved Endways 136 Feet

Three 297-ft. 1000-ton truss spans of the Missouri River bridge at St. Joseph, Mo., were shifted 136 ft. 9 in. to new piers on Nov. 14. These piers were built between the old ones, as described in *Engineering News-Record* of Oct. 25, p. 780, and the spans were moved longitudinally to their new supports. For this purpose falsework was built under the spans, supporting a standard-gage railway track under each truss. On these tracks were placed railway-car trucks, of the type used for 100,000-lb. freight cars. A 300-ton hydraulic jack was mounted on each truck, and all the jacks of each span were connected by piping to insure equal distribution of the load.

There were 12 power trucks under each span, with two idler trucks at the middle. A rigid draft rigging connected all the trucks of the three spans, and at its forward end was a pulling beam to which the four hauling tackles were attached.

An electric hoist of 240 hp. operated the cables, and the movement of the 3000-ton load was accomplished in 13 minutes. The work was done by the American Bridge Co., under the direction of R. L. Huntley, chief engineer of the Union Pacific Railway.

Steel for Government Now in Hands of J. L. Replogle

Governmental iron and steel interests, other than ordnance for the United States and allied countries, have been entrusted by the Council of National Defense to J. L. Replogle, vice president of the American Vanadium Co., who will act as director of steel supplies and will have charge of the distribution and be responsible for the prompt and proper execution of all orders.

Mr. Replogle will receive weekly reports from the iron and steel producers, showing the tonnage of iron and steel of the various classifications on order for the United States and allied governments, as well as domestic and foreign orders for general purposes. He will also receive information on mill capacities and mill production, and in cases of retarded output will secure reasons therefor and will endeavor, in conjunction with the manufacturers and the War Industries Board, to remove obstacles which prevent maximum output of war necessities.

Civil Engineers to Have Reserve Corps in the Navy

Examination for Entrance Into Body Similar to Army's Will Close Dec. 31—Qualifications Described

An examination, closing Dec. 31, is to be held to select an eligibility list of candidates for enrollment as civil engineers in the United States Naval Reserve Corps, thus establishing for civil engineers and men in allied branches of construction work the opportunity to become enrolled in a corps in the navy similar to that established over a year in the Corps of Engineers of the United States Army. Successful candidates will be enrolled as required in the United States Navy and will be assigned the provisional rank of ensign, lieutenant (junior grade) and lieutenant, and will be detailed to the work going on under the direction of the Bureau of Yards and Docks of the Navy Department.

The requisites for eligibility are as follows: The candidate must be an American citizen and an engineer in the active practice of the profession of civil, electrical or mechanical engineering, or some business directly connected therewith. To be eligible for the rank of ensign, the candidate must be not less than 24 years of age and in active professional practice not less than two years. To be eligible for the rank of lieutenant (junior grade) the candidate must not be less than 27 years of age and in active professional practice not less than five years, and to be eligible for the rank of lieutenant, the candidate must not be less than 30 years of age and in active professional practice not less than seven years, and must have had responsible charge of work as principal or assistant for at least three years. If approved, the candidate must pass the medical requirements of the United States Navy. Anyone who is now in the army, either volunteer or drafted, may make application, but must obtain his discharge before he can be enrolled. This includes anyone who has been directed to appear before an exemption board. Those now in the United States Naval Reserve Force are also eligible.

Upon enrollment the successful candidate will receive the pay and allowance of an officer in the regular navy, which are approximately: For ensign, $2100; lieutenant (junior grade), $2500; lieutenant, $3100. This includes allowances for commutation of quarters, heat and light, and there is an additional allowance of $150 for uniform. Enrollments are for a period of four years or during the existence of a war or national emergency. Except during a war or national emergency, officers are only given active duty at their own request, and then for short periods.

A permit to take the examination is not required, although a circular for the information of a person desiring to enter the corps is available by writing to the Reserve Examining Board, Bureau of Yards and Docks, Navy Department, Washington, D. C. To compete in the examination it is necessary to fill out the blank spaces in the notification blank, which is obtained by writing to that board and to address a letter to the examining board including the following information: Name, address, voting place, occupation, place and date of birth, height and weight, married or single, children, photograph, evidence of American citizenship, college from which graduated, details of graduation, testimonials in regard to character and moral fitness, testimonials from employers or others conversant with employee's professional ability, chronological statement in detail of professional experience and six names of persons conversant with the candidate's professional ability. All of these details are further elaborated in the circular noted above. If in the opinion of the examining board further examination of candidates is considered desirable, such candidates may be authorized to appear in person before the examining board in Washington.

This opportunity is open for a period of about six weeks more; that is, all applications must be in before Dec. 31 of this year. No announcement has been made of the number of appointments which will probably be made, but it is understood there are openings for a good many men. Work for the Bureau of Yards and Docks comprises all of the construction operations carried on by the navy—that is, piers, cantonments, wharves, dry docks, warehouses, etc., both here and abroad.

Engineers in St. Paul Are Well Organized

The installation of a chapter of the American Association of Engineers in St. Paul Oct. 7 added one more to the list of 16 engineering organizations in the St. Paul-Minneapolis district. Mayor J. A. Irvin welcomed the organization to the city and invited its aid in a city-planning campaign. A resolution offering coöperation and affiliation with existing organizations in the district was adopted.

Engineer Officers Assigned to Military Mapmaking

The following-named officers, Engineer Officers' Reserve Corps, are relieved from duty at the engineer training camp, Fort Leavenworth, Kan., and will report by letter to the director, United States Geological Survey, for assignment to duty connected with military mapping: Second Lieuts. Elmer LeC. Goldsmith, John W. Lewis, Edward J. Francis, Elmo N. Murphy, Carl R. French, William D. Lewis and Charles B. Moore.

The following-named officers, Engineer Officers' Reserve Corps, are relieved from duty at the engineer training camp, American University, District of Columbia, and will report by letter to the director, United States Geological Survey, for assignment to duty connected with military mapping: Second Lieuts. Charles M. Madden, Edward H. Stelle, Frederic E. Smith, Edward P. Asbury, George B. Davidson, Frederick W. Look, Gordon D. Cooke, Joseph W. Geary, Jr., and Walter K. Wood.

Second Lieut. Herman J. Switzer, Engineer Officers' Reserve Corps, is assigned to active duty under the director, United States Geological Survey, for duty connected with military mapping.

Illinois Water-Works Officials See Industries of Peoria

Inspection of industrial plants, all of which are being greatly enlarged, was the feature of the annual fall meeting of the Illinois Section of the American Water-Works Association at Peoria, Nov. 15. An exhibition was staged of the Holt caterpillar tractors on the field where officers and soldiers are being trained to operate the unarmed "tanks." Light farm tractors were most in evidence at the Avery plant. The Keystone Steel and Wire Co. is starting on a most extensive enlargement of its plant. It is inaugurating river transportation of ore from Alabama, having excavated a barge canal from the river to the plant.

After the banquet C. B. Burdick, consulting engineer, described the construction of Camp Grant at Rockford, Ill., from the standpoint of magnitude, methods, speed and organization (see *Engineering News-Record*, Aug. 30, p. 388). The three reasons which made it possible for the Government, usually so deliberate, to house 600,000 men in 75 days were: 1. An elastic and elaborate set of instructions of 100 pages. 2. Good contractors. 3. Responsibility vested in quartermasters who were given almost absolute power.

H. B. Morgan, manager of the Peoria Water-Works Co., presented the facts as to the present conditions of the Lakes-to-the-Gulf deep waterway. He stated that recently an injunction had been dissolved against the use of $5,000,000 appropriated by the state for an 8-ft. connection between the Chicago drainage canal and the Illinois River.

Concrete Substituted for Steel in Building Elevated Road

In order to prevent an undue delay in construction, owing to inability to obtain necessary steel, the Public Service Commission for the First District, New York, has decided to have Section 3 of the Culver Rapid Transit R.R. in Brooklyn, from Avenue X to Coney Island, built for the most part as a reinforced-concrete structure. This section, which is elevated, extends from a point 500 ft. south of Avenue X on Shell Road to the vicinity of Sheephead Bay Road.

The commission last summer received bids for the construction of this portion of the line, but on account of the high prices quoted for steel and the twenty months required for delivery of this material, rejected the bids and took the possibility of an alternative scheme under consideration.

Strong Appeal to Lumbermen for Ship Supplies

In connection with the campaign for speeding up the shipbuilding program, Charles S. Keith, president of the Southern Pine Association, has sent out the following letter to 1000 manufacturers of Southern pine, including both members and nonmembers of the association. It applies to every industry:

"We are engaged in war. Our first duty is to our country and its allies. Material, supplies and food are essential to final victory. Without shipping facilities, our caues is lost. It is up to us to see that the wooden shipbuilding program is not delayed, but expedited. Our greatest need is ships, ships and more ships. We must build faster than Germany can sink. Any manufacturer who does not do his part, by cutting, in advance of the ordinary comprehensive logging operations, the necessary high-grade timber suitable for shipbuilding, and who will not refuse to take orders for material which interfere with the Government orders, is a slacker and a traitor, and is encouraging and assisting our enemies.

"Under such conditions the Government would be justified in the seizure and operation of his plant in the nation's interest, and the association will encourage and assist the Government in such action. No loyal American will thwart such a program, but will aid. We are appealing to you for the best that is in you and the industry."

Rivers and Harbors Congress Indefinitely Postponed

Owing to the difficulty of obtaining hotel accommodations in Washington at present, the fourteenth annual convention of the National Rivers and Harbors Congress, which was scheduled to meet in Washington on Dec. 5-7, has been postponed until further notice. The officials of the congress say it is impracticable to complete arrangements for holding the convention in some other city on the date originally announced.

Urge Raising of Imperial Valley Levees

At a recent meeting of directors of the Imperial Valley District, C. R. Clarke, chief engineer of the district, reported that the last high water in the Colorado had left a "cone" of sand and silt along the Abejas channel of the river as high as the Saiz or Volcano Lake levees, and that unless the levees were raised or the river turned back into the channel followed prior to 1909, the next high water would be diverted northward, causing much damage and flowing into the Salton Sea. Mr. Clarke had just completed a survey of Lower California and states that the threatened danger can be averted by either raising the levees 5 or 6 ft. or by the restitution and strengthening of the Ockerson levee to throw the river back into its old channel. The latter course was preferable, he asserted, and would cost approximately $893,486, as against an expenditure of $1,327,000 for raising the Saiz and Volcano Lake levees.

A bond issue recently voted by the district included an item of $650,000 for raising these two levees.

F. S. Sellew, formerly Government engineer in charge of the Yuma project, has recently stated that to protect the valley from water shortage and inundation immediate steps should be taken to repair and extend the Ockerson levee to the Bee River at its junction with the old bed of the Colorado, closing the Bee River and extending the levee one mile beyond.

Architects' Institute Mobilizes Men for Service

Architects throughout the country have been mobilized for war service by the American Institute of Architects. Some are now in France supervising the building on the aviation fields to be used by America's air forces, others are in training in this country, notably in the camouflage battalion at the American University Camp, Washington, D. C. Three thousand are already at the disposal of the Government.

Civilian Engineers Join Staff of Emergency Fleet Corporation

Reports published that Rear Admiral Washington L. Capps, U. S. N., had been relieved of all responsibility in connection with the Government's shipbuilding program, of which he has been in charge as general manager of the Emergency Fleet Corporation, and that Charles A. Piez, a Chicago engineer recently appointed vice president of the corporation, would be put in supreme charge, have been vigorously denied at the fleet corporation office in Washington.

The understanding at that office is that no "shake-up" has taken place, but that there has been an expansion of the work of the office, under which Admiral Capps will continue in charge of the technical details of the work and Mr. Piez will be in charge of business mat-

... in connection with the work. In short, there has been a coördination of effort, and assistance has been provided by bringing into the organization a number of engineers from civilian life. An attempt has been made, in this way, to place the corporation on a business basis, rather than a military basis. It is understood that Rear Admiral F. F. Bowles, U. S. N., retired, will give way to James Heyworth, a Chicago contractor, as head of the wooden ship construction department, although it is not true that there are to be wholesale retirements of naval officers from the work. Rear Admiral H. H. Rousseau, U. S. N., remains as manager of the division of shipyard plants. Charles Day, a Philadelphia engineer, now in England doing research work on the subject, will have charge of the supervision of the building of fabricated steel ships. A. J. Mason, another Chicago engineer, will have charge of inspection work in the field.

Foreign Trade Convention Feb. 7

The Fifth National Foreign Trade Convention will be held at the Gibson Hotel, in Cincinnati, on Feb. 7-9. The principal topic will be foreign trade in its relation to the war.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, 29 West 39th St., New York; Jan. 16 and 17, 1918, New York; Charles Warren Hunt, secretary.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York; Dec. 4-7, New York; Calvin W. Rice, secretary.

GENERAL CONTRACTORS' ASSOCIATION; 51 Chambers St., New York; Dec. 8, New York; C. A. Crane, secretary.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, 35 Nassau St., New York; Jan. 14, New York; F. A. Molitor, secretary.

NEW ENGLAND WATER-WORKS ASSOCIATION; 715 Tremont Temple, Boston; Jan. 9, Boston; Willard Kent, secretary.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; Richmond, Va.; Dec. 4-6, Richmond, Va.; Joseph Hyde Pratt, secretary, Chapel Hill, North Carolina.

AMERICAN WOOD PRESERVERS' ASSOCIATION; Baltimore, Md.; Jan. 22-24, Chicago; F. I. Angier, Baltimore & Ohio R.R., Mount Royal Station, Baltimore, Md., secretary.

CANADIAN SOCIETY OF CIVIL ENGINEERS; Montreal; Jan. 8, Montreal; Fraser S. Keith, 176 Mansfield St., Montreal, Can., secretary.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS; Dec. 27-29, Chicago; C. K. Shedd, Ames, Ia., secretary.

The fifth annual session of the Washington Irrigation Institute, E. F. Benson, president, will be held in North Yakima, Wash., Dec. 10 and 11.

The general meeting of the Engineering Society of Buffalo, N. Y., was held Nov. 14, the sections joining in the meeting. C. H. Norton, of Worcester, Mass., spoke on "The Modern Cylindrical Grinding Machine."

The Louisiana Engineering Society held its regular meeting in New Orleans on Nov. 12. The technical exercises consisted of a paper entitled "Yellow Pine Industry in the South," by R. E. Hartman.

The Providence Engineering Society at its November meeting, held Nov. 20, was addressed by Chester L. Lucas, associate editor of *Machinery*, on "The Machining of a 9.2-in. High-Explosive Shell," illustrated by moving pictures. On Dec. 5 the Structural Section of the society will hold its opening meeting, which will be devoted to a discussion of "Foundation Work in Providence."

The British Columbia Institute of Civil Engineers, Victoria, B. C., elected the following officers recently: Chairman, F. M. Preston; secretary, A. O. Noakes; council, B. Hutchison, A. G. King, E. N. Horsey, W. N. Stokes and J. H. Bevey.

The Canadian Society of Civil Engineers held the second meeting of its 1917-18 session on Nov. 8. A series of motion-picture films on the water powers of Canada was shown, with an introduction by J. B. Challies.

The Albany Society of Civil Engineers will hold its regular meeting in Keeler's Hotel, Nov. 27. C. W. Boynton, of the Cement-Gun Co., Inc., Allentown, Penn., will deliver an illustrated address. The proposed amendments to the constitution of the soceity will be presented for action at the regular meeting.

The Structural Section of the Engineers' Society of Western Pennsylvania held its bimonthly meeting Nov. 13. A paper on "Industrial Housing" was read by H. Walter Forster, general manager, Independence Bureau, Philadelphia. Members of the society made an inspection trip on Nov. 17 to the new industrial housing development near the Donora, Penn., plant of the American Steel and Wire Co., followed by an inspection of the steel works. The regular monthly meeting of the society was held on Nov. 20. The feature of the meeting was an illustrated talk on "Radio Telegraphy and Telephony," by S. M. Kintner, general manager, National Electric Signaling Co., Pittsburgh, Pennsylvania.

The Engineers' Club of Trenton, N. J., will hold a special meeting, Nov. 22, at which J. A. Shorey, of the General Electric Co., will deliver an illustrated address on "Centrifugal Blowing Engines."

The Colorado Association of Members of the American Society of Civil Engineers was addressed Nov. 10 by James Munn, engineer, U. S. Reclamation Service, on "The Construction of the Arrowrock Dam." At the December meeting, James M. Gaylord, electrical engineer, U. S. Reclamation Service, will speak on the experience of the reclamation service with reservoir gates and outlet.

The American Society of Agricultural Engineers will hold its eleventh annual meeting at the Morrison Hotel, Chicago, on Dec. 27 to 29. Sewage disposal, land drainage, design and lighting of farm buildings, the use of tractors, and engineering work in food supply are among the subjects included in the program. The secretary is C. K. Shedd, Ames, Iowa.

Dayton Engineers' Club expects to inaugurate its new clubhouse Jan. 1. The club has a scientific section and further development of sections is probable. The plans so far outlined make nearly the whole year's program of biweekly meetings consist of men from out-of-town. The plan followed in developing a program is to assign a particular member of the program committee to each meeting, making it his primary responsibility, aided by suggestions only from the committee, to select and secure the speaker.

PERSONAL NOTES

MAJ. BENEDICT CROWELL, Cleveland, Ohio, engineer officer now in charge of the Washington office of the Panama Canal, has been appointed Assistant Secretary of War to succeed William M. Ingraham. Mr. Crowell is a native of Cleveland. Immediately after the formation of the National Council of Defense he went to Washington and became associated with the work of the General Munitions Board especially in connection with field production. As engineer in charge of the Washington office of the Panama Canal he relieved Lieutenant Colonel Browne of the regular army, who entered field service. It was announced that Major Crowell would resign his commission as engineer officer in order to accept the position of Assistant Secretary of War.

HAROLD D. HYNDS, of the Turner Construction Co., New York City, has resigned as secretary of the American Concrete Institute, on account of his acceptance of a commission in the Signal Corps, U. S. A. His successor as secretary is H. B. ALVORD, of the Aberthaw Construction Co., Boston. Mr. Alvord was graduated from Massachusetts Institute of Technology in 1907 and after some years as instructor at that school and as assistant professor at Bowdoin College, entered the Aberthaw Co. The address of the American Concrete Institute is now 27 School St., Boston, Mass.

A. N. REECE, first engineer of the Kansas City, Southern and the Arkansas Western, has been promoted to division engineer of those roads, with

headquarters at Pittsburg, Kan., succeeding G. H. COOK, resigned.

W. ATWATER, who has been in Modesto, Calif., for several years collecting data for San Francisco to be used in connection with the suit of the Modesto district against that city, has been appointed engineer for the State Water Commission.

J. FRANK BOWAN has been reappointed superintendent of roads and bridges and city engineer of Manchester, Connecticut.

A. J. WITCHELL, engineer of tests, with the Spokane, Portland & Seattle Ry., has been appointed assistant to the general superintendent, Portland, Oregon.

PHILIP F. MILLER, formerly sales engineer for the Pacific Flush Tank Co., has been commissioned first lieutenant in the Ordnance Officers' Reserve Corps.

G. E. VOTAW has been appointed superintendent of the Portland, Ore., division of the Great Northern Ry., succeeding C. A. VERMILLION, retired on account of ill health.

GEORGE K. LARRISON, formerly chief engineer and hydrographer of the Territorial Land Office at Honolulu, has been called into active service as captain in the Engineer Officers' Reserve Corps.

CHARLES T. BAILEY has been appointed chief engineer and hydrographer of the Territorial Land Office at Honolulu, H. T., to succeed CAPT. GEORGE K. LARRISON. Mr. Bailey has been in Hawaii since November, 1912, and he became assistant to Mr. Larrison in November, 1915.

LEE H. POWELL, who was appointed city engineer of Tyler, Tex., has been retained as consulting engineer on Road District No. 1, Sheridan County, Texas, having been chief engineer on that work until Aug. 1.

GEORGE L. KELLY has been appointed assistant to the manager of the American Construction Co., engaged in erecting the aviation camp at Olcott, Texas.

WILLIAM M. TORRANCE, vice-president and chief engineer of the Carson Construction Co., of Savannah, Ga., is now a captain in the Twenty-third Engineers at Camp Meade, Maryland.

H. C. ALLEN, of Wallace, Idaho, has been appointed state highway engineer to succeed E. M. BOOTH, who has resigned his position to enter the army engineering service. Mr. Booth has been highway engineer of Idaho since May, 1915.

CHARLES T. PARKER, of Moffatt & Parker, consulting engineers, Oregon City, Ore., has received a commission as first lieutenant in the Corps of Engineers, U. S. Army.

A. L. STRONG, formerly with the Chicago, Milwaukee & St. Paul Ry., is now connected with the county engineer's office of Spokane County, Washington, as inspector and engineer in charge of the construction of concrete roads.

HOWARD A. VIERHELLER, who was with the Conemaugh division, Pennsylvania R.R., at Pittsburgh, is now instructor in civil engineering at the Georgia School of Technology.

PAUL MOLITOR, supervising engineer, has been reappointed for another year for the Madison-Chatham sewerage plant, Chatham, N. J.

JOE MANWARING, formerly superintendent of the Butte-Balaklava Mining Co., has been appointed county engineer of Silverbow County, Montana, to succeed CHARLES M. FEENEY, deceased.

CECIL D. COIL has resigned as superintendent for H. S. Siebert, mausoleum contractor, and is now superintendent for the York Mausoleum Construction and Supply Co., Easton, Pennsylvania.

T. LEROY PIERCE has resigned as assistant superintendent of parks, of Wilmington, Del., to become connected with Lincoln Highway survey work in Delaware. He will have charge as resident engineer when construction work is to be done.

ELMER HENBECK, until recently employed by the Pennsylvania Water and Power Co., has been commissioned first lieutenant in the Engineer Officers' Reserve Corps.

HOLMES A. FRANK, formerly with the Pennsylvania R.R., then with the Foundation Co., of New York, and later in the contracting business in the Maritime Provinces, is now building ships at Liverpool, Nova Scotia.

J. A. HEAMAN, assistant to the chief engineer of the Grand Trunk Pacific, has been appointed assistant chief engineer, with headquarters at Winnipeg.

PROF. EDWARD BARTOW, director Illinois State Water Survey, has been appointed major in the sanitary corps. G. C. HABERMEYER has been appointed acting director of the Water Survey and acting secretary of the Illinois section of the American Water-Works Association during Major Bartow's absence.

GEORGE H. HERROLD, St. Paul, has been elected to represent the Civil Engineers' Society of St. Paul on the Minnesota Joint Engineering Board to succeed Maj. GEORGE W. RATHJENS, 313th Engineers, now stationed at Camp Dodge, Iowa.

O. E. MALSBURY resigned as assistant engineer in charge of the Division of Surveys of the Panama Canal to take up his duties as captain in the Engineer Officers' Reserve Corps at the training camp at Camp American University, District of Columbia.

ALFRED D. BUTLER, for nine years assistant city engineer of Spokane, Wash., has been appointed city engineer to succeed MORTON MACARTNEY, who resigned to become connected with Porter Bros., contractors, of Spokane. Mr. Macartney had been city engineer seven years and a half.

MURRAY C. AYERS, until recently draftsman for the Union Oil Co., at Los Angeles, is now chief of party on road surveys in Tuolumne County, California, for the California Highway Commission.

M. B. DABNEY has succeeded E. BLANCHARD as highway engineer of the Monticello, Miss., district. Mr. Blanchard goes to Yazoo City, Miss., to engage in the same line of work.

L. DREW GODDARD, engineer of docks, wharves and bridges, Detroit, Mich., has been commissioned captain in the Engineer Officers' Reserve Corps.

FRANK L. MCLAUGHLIN, of the Foundation Co., has been transferred to the Pittsburgh district, where he is now in charge of construction of the power station at Windsor, W. Va., for the American Gas and Electric Company.

F. E. HANSON, of the valuation department, New York, New Haven & Hartford R.R., has been commissioned captain in the Engineer Officers' Reserve Corps.

MURRAY BLANCHARD, formerly assistant engineer, the Sanitary District of Chicago, is now captain in the Engineer Officers' Reserve Corps, Ft. Leavenworth, Kansas.

WARREN F. RUGG has been transferred from the New York State Highway Commission to the Bronx Parkway Commission, with headquarters at Bronxville, New York.

CHARLES E. PARRY, formerly city engineer of Ft. Frances, Ont., Canada, is now assistant chief draftsman with the Tampa (Fla.) Dock Co., on detail work for the standard wooden ships for the U. S. Shipping Board, Emergency Fleet Corporation.

MAURICE SCHOTLAND, formerly in the division of designs, Public Service Commission, First District, New York, is now with the Department of Operation and Maintenance, Building Division, Panama Canal.

ADOLF HINRICHS, formerly designer in the office of engineer of structures, New York Central R.R., is now structural engineer in the office of Albert Kahn, architect, Detroit.

R. F. MIRICK, formerly with the Division of Valuation, Interstate Commerce Commission, has become connected with the Gulf Plainville Northern Railroad.

ARTHUR G. LIVINGSTON, formerly with the Board of Water-Supply,

Manhattan Division, New York City, is now first lieutenant, Engineer Officers' Reserve Corps, at Camp American University, District of Columbia.

J. B. DAWSON has been made division engineer of the Southern Pacific Co. at Stockton, Calif., vice G. W. CORRIGAN, who has been transferred to division engineer at Bakersfield, Calif., vice J. P. EDWARDS, resigned.

G. B. FARLOW, formerly second assistant engineer, Southwest district, Western lines, Baltimore & Ohio R.R., is now first lieutenant in the Engineer Officers' Reserve Corps.

ARTHUR L. WARD, who has been engaged in surveying and engineering in western Washington since 1907, is now first deputy under county engineer of Pacific County.

PHIL S. WICKERHAM, Portsmouth, Ohio, formerly in the Government service, Bureau of Public Works, Philippine Islands, has been commissioned captain in the Engineer Officers' Reserve Corps.

CLAUDE C. WASHINGTON, having entered the military service, resigned as resident engineer for the Crystal Block Coal and Coke Co., at Sprigg, W. Va., and has been succeeded by J. H. JONES, of Big Stone Gap, Virginia.

CHARLES M. WHELAN, formerly hydraulic engineer of the Rochester Ry. and Light Co., Rochester, N. Y., is now with the Aluminum Co. of America, Pittsburgh.

A. M. DAVIDSON, first assistant engineer, Southwest district, Western lines, Baltimore & Ohio R.R., has been commissioned captain in the Engineer Officers' Reserve Corps.

WALTER W. GRUBER, formerly chief of party, valuation work, Baltimore & Ohio main line, is now captain in the 308th Regiment of Engineers, at Camp Sherman, Chillicothe, Ohio.

GUY S. MASON, supervising engineer and construction superintendent for the Stewart Engineering Corp., is in charge of construction at the U. S. Naval Station, Guantanamo Bay, Cuba.

M. M. COOK was elected city engineer of Wichita Falls, Tex., vice L. C. HINCKLEY, deceased.

J. M. LEWIS, assistant engineer, Northwest district, Western lines, Baltimore & Ohio R.R., has been assigned to the Second Officers' Training Camp at Ft. Benjamin Harrison, Ind.

C. F. KOPPISCH resigned the position of resident engineer of construction for the Southern New England Railroad Corporation, to accept a position as engineer of construction to construct a railroad from Belgravia, Ariz., connecting with the Ray & Gila Valley R.R., with headquarters at Kelvin, Arizona.

DONALD M. BAKER, formerly a deputy in the county surveyor's office for Orange County, California, is now engineer in the California State Water Commission.

MAX DEITENBECK, formerly assistant engineer in the chief engineer's office of the Gulf, Colorado & Santa Fé Ry., is now assistant engineer in the office of the resident engineer, Kansas City, Mexico and Orient R.R. Co., Kansas City, Missouri.

WALTER G. DANIEL, formerly assistant to the county engineer of Hamilton County, Tennessee, has been appointed an assistant state highway engineer, Tennessee Department of Highways.

THORN DICKINSON, connected formerly with the Valuation Committee of the Chesapeake & Ohio R.R. at Richmond, Va., is now officer in charge of the engineer sub-depot, Camp Greene, N. C., with the rank of second lieutenant in the Engineer Officers' Reserve Corps.

JAMES BRAKES, JR., who was an instructor in mechanical engineering, laboratory and experimental engineering at Syracuse University, is now technical assistant for the Kimberly-Clark Co., Neenah, Wisconsin.

A. M. ZABRISKIE, engineer of design of the Central R.R. of New Jersey, has been made principal assistant engineer. This position has been vacant since July, 1916, when A. E. OWEN was advanced to chief engineer to succeed the late J. O. OSGOOD. Mr. Zabriskie has been in the employ of the Central R.R. of New Jersey since 1904, serving successively as transitman, assistant engineer and engineer of design. Prior to 1904 he was with the Lehigh Valley R.R. two years.

THOMAS W. COTHRAN, of Greenwood, S. C., has been appointed chairman of the State Highway Commission, vice Maj. Monroe Johnson, recently ordered to report for foreign service.

T. D. MYLREA recently resigned as engineer of tests of the city architect's department, Toronto, to become chief engineer of the Trussed Concrete Steel Co. of Toronto.

HENRY F. JONAS, until recently engineer of structures for the Southern Pacific Co. in Texas and Louisiana, has been chosen as supervising engineer for the work of reconstructing the Galveston causeway. Mr. Jonas has been connected with the Southern Pacific since 1890, resigning Oct. 24 to accept his new position.

S. E. SHOUP, of the Kansas City Southern Ry., has been appointed acting division engineer of the Kansas City terminal division, to succeed A. LECKIE, division engineer, who has been temporarily assigned to other duties.

F. B. MARSH, assistant designing engineer of the Board of Water Supply, New York, has resigned in order to become resident engineer, New York District, for the Emergency Fleet Corporation.

JAMES O. HEYWORTH, contractor and engineer, Chicago, was recently appointed a member of the Shipping Board. Mr. Heyworth has constructed three Government locks and dams on the Warrior River, jetty work at Fernandina, Fla., and Port Arthur, Tex., and work at the cantonments for Camps Decatur, Farragut and Ross at Great Lakes, Ill., among other works of importance.

W. J. DURBIN, superintendent of water-works, Evansville, Ind., and A. G. HUSTED, of Cleveland, Ohio, have been added to the staff of the Indianapolis Board of Sanitary Commissioners.

GEORGE P. MILLER is now assistant superintendent of the Delaware and Raritan Canal, Pennsylvania Lines East of Pittsburgh. On Apr. 19, 1887, Mr. Miller entered the service of the Pennsylvania R.R. as rodman. After service in various capacities, including that of supervisor of signals, New York division, and supervisor of New York division "A," Mr. Miller on Nov. 1, 1901, was promoted to assistant engineer of the Buffalo division, and on Aug. 20, 1903, was appointed assistant engineer, New York division. On Jan. 1, 1909, he was promoted to principal assistant engineer of the New Jersey division.

JOHN C. PAYNE, Jersey City, N. J., formerly engineer and secretary with the Riparian Commission and the New Jersey State Board of Commerce and Navigation, has been appointed city expert to look after the city interests in its tax suits against various railroads.

R. B. SLEIGHT, assistant irrigation engineer, has left the Department of Agriculture for active duty with the aviation section of the signal corps.

JOSEPH J. RHOADS, appointed superintendent of the Allegheny division, Pennsylvania Lines East of Pittsburgh, with office at Oil City, Penn., began work for the Pennsylvania as a rodman in March, 1889. After service as assistant supervisor and supervisor in various divisions, he was promoted to division engineer, Eastern and Susquehanna divisions, on July 1, 1905. In 1907 he was made division engineer at Philadelphia, then to the middle division as division engineer in 1910, and on June 16, 1913, he was promoted to superintendent of the Central division. He has also been superintendent of the Schuylkill division.

ELBERT M. CHANDLER recently became consulting engineer for the Selah Noches Irrigation District of the Yakima Valley and has charge of the design of the permanent reconstruction of the Selah Canal system. Mr. Chandler was for seven years chief engineer of the Burbank project in Walla Walla County. He is also first vice president of the Washington Irrigation Institute and a graduate of the University of California, 1907.

PUGH & HUBBARD, Philadelphia, have closed their office, owing to the commissioning as major in the Engineer Officers' Reserve Corps of Mar-

shall R. Pugh, who is now commanding the First Battalion, Twenty-First Engineers (Light Railway). The regiment is stationed at Camp Grant, Rockford, Illinois.

R. H. PINKHAM, division engineer of the Pennsylvania at Erie, Penn., has been appointed division engineer of the Pittsburgh division, JOHN ATLEE, supervisor of the division at East Liberty, Penn., succeeding him.

H. H. TEMPLE has been appointed chief engineer of the Pittsburgh & West Virginia Ry. and the West Side Belt R.R., vice W. F. PURDY.

C. WHITFIELD, roadmaster of the Portland division of the Spokane, Portland & Seattle, has been appointed superintendent maintenance-of-way, headquarters at Portland, Ore., the title of roadmaster having been abolished.

R. H. THOMSON, consulting engineer, Seattle, Wash., has been employed by the Public Service Commission of that state to prepare a railroad terminal map of Seattle yards, which will become the standard plan of adjusting switching differences for all railroad centers in the state.

H. W. WAGNER, district engineer of the Atchison, Topeka & Santa Fe at La Junta, Colo., has been promoted to chief engineer, eastern lines, headquarters at Topeka, Kan., succeeding R. A. RUTLEDGE, transferred to La Junta as district engineer on account of ill-health.

JAMES T. GILLICK, formerly assistant general manager of the Chicago, Milwaukee & St. Paul Railroad Co., has been appointed general manager, succeeding P. C. HART, assigned to other duties. MACY NICHOLSON, formerly assistant to the operating vice president of the Great Northern Railway Co., succeeds Mr. Gillick.

E. F. MILTNER, formerly resident engineer for Black & Veatch, Kansas City, Mo., in charge of pavement and sewer construction at Garnett, Kan., has been appointed county engineer of Anderson County, Kansas.

T. J. WILLIAMS, JR., has resigned as division engineer of the St. Louis Southwestern Ry. of Texas, at Mount Pleasant, Tex., and has been succeeded by H. J. GRAESER, promoted from office engineer at Tyler, Texas.

JEROME H. FERTIG, formerly assistant engineer in the United States Reclamation Service, is now assistant to the project engineer, Odioco Project, Prineville, Oregon.

L. J. VOORHIES, at one time chief of party on Federal valuation of railways for the Interstate Commerce Commission, has resigned as district engineer for the J. B. McCrary Co., engineers, Atlanta, Ga., to become associate professor of civil engineering at the Texas Agricultural and Mechanical College.

F. H. SHEPHERD, federal member of Parliament for Nanaimo, B. C., has accepted the office of inspector of dredges for British Columbia. Mr. Shepherd is an engineer by profession, and has been connected with mining and railway work in Canada, Australia, New Zealand and Alaska. At one time he was chief inspector of mines in British Columbia, which position he resigned in 1911 to enter Dominion politics.

F. W. HILLMAN has been made division engineer of the Chicago & Northwestern, with headquarters at Madison, Wis., in place of L. JUTTON, who has been transferred to the Wisconsin division, headquarters at Chicago. Mr. Jutton succeeds S. S. LONG.

F. O. BROILI has accepted the position of engineer of Public Utilities Commission of the State of Nevada, succeeding W. K. FREUDENBERGER.

S. E. ROBERTSON has been confirmed by the Fiscal Court of Shelbyville, Ky., to succeed G. MURRELL MIDDLETON as county road engineer.

CHARLES M. SCHULTZ, formerly with the New York State Department of Highways, is now with the Central Products Co., of New York.

WILBUR R. GREENLUN, formerly assistant engineer, Mason City, Iowa, has been appointed county engineer of Decatur County, Iowa.

E. O. CARLSON has left the position of assistant engineer of the New York, New Haven & Hartford R.R., with offices at New Haven, Conn., to enter military service, and has been succeeded by A. A. CROSS.

WALTER J. BENNETT, of the bridge department of the Great Northern Ry., has been commissioned as captain in the Engineer Officers' Reserve Corps, and is now in the training camp at Vancouver Barracks, Washington.

U. S. MARSHALL, formerly assistant engineer in the office of the Sacramento County, California, highway commission, is now road engineer in the army cantonment at Camp Lewis, American Lake, Washington.

E. IRVINE RUDD, for the past four years assistant engineer with the Central R.R. of New Jersey, has been appointed engineer of the Public Utilities Commission of Connecticut during the absence of JOHN F. TRUMBULL.

E. J. UMSTEAD has been appointed chief draftsman of the mechanical division of the Bureau of Water, City of Pittsburgh. The division has charge of the design, erection, operation and repair of pumping stations.

CAPTAIN JOSEPH C. WATKINS, who was manager of the McDonald Land and Mining Co., Joplin, Mo., is now at the Second Engineer Officers' Training Camp, Fort Leavenworth, Kansas.

C. H. KNOWLES, Portland, Ore., in charge of Multnomah County's engineering department, recently received a commission as recruiting officer for the 23rd (Highway) Regiment of Engineers, United States Army.

J. D. JUSTIN, formerly resident engineer for the Fargo Engineering Co. on the construction of the recently completed Wissota Dam at Chippewa Falls, Wis., for the Wisconsin-Minnesota Light and Power Co., is now connected with James H. Fuertes, consulting engineer, New York City.

CHARLES W. MURRAY has been reappointed city engineer of Miami, Fla., for a term of two years.

W. O. RENKIN, formerly chief engineer with the A. M. Byers Co., Pittsburgh, has resigned to become manager of the engineering department of the Quigley Furnace Specialties Co., New York City. Mr. Renkin spent some years as resident engineer in charge of organization and construction of the work and Town of Sakchi, Bengal, India, for the Tata Iron and Steel Company.

L. M. NORELIUS has become associated with F. C. SHENEHON, consulting engineer, Minneapolis, as engineer in charge of a large spillway in connection with flood-control improvements at Sioux Falls, South Dakota.

OBITUARY

JAMES P. MCNICHOL, contractor, Philadelphia, died there Nov. 14. He was born in Philadelphia 53 years ago. After graduating from high school, he entered the firm of Daniel J. McNichol & Co., which was founded by his uncle. His father was also a contractor. Mr. McNichol was prominent in city politics and held the office of state senator.

LIEUT. J. H. CARDEW, M. C., graduate of McGill University, died Oct. 5 of wounds received in action on the French front. He was at one time electrical engineer of the Indian Government State Railways.

LIEUT. COL. THOMAS C. IRVING, D. S. O., commanding officer of the First Canadian Engineers, has been killed in action on the French front. As a captain he went over seas at the outbreak of the war with the Second Field Company of the Canadian Engineers. Lieutenant Colonel Irving was an associate member of the Canadian Society of Civil Engineers and a member of the Engineers' Club, Toronto. Prior to enlistment he was vice president of the Moffat-Irving Electric Smelters, Ltd., Toronto.